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Summary of Outreach Activities for California's Seismic Hazards Mapping Program

1996-1998

SPECIAL PUBLICATION 121

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Cover Photo: Liquefaction damage at Kings Harbor in Redondo Beach, Los Angeles County, caused by the January 17, 1994 Northridge earthquake. *Photo by Al Barrows, DMG.*

Special Publication 121

Summary of Outreach Activities For California's Seismic Hazards Mapping Program

1996-1998

by

Theodore C. Smith and Bea McKamey

Technical Report For:

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TABLE OF CONTENTS

ACKNOWLEDGMENTS v

EXECUTIVE SUMMARY vii

INTRODUCTION ix

- Justification and Need for This Study ix
- Statement of the Problem ix
- Limitations of This Study ix
- Organization of This Report x

CHAPTER 1—HISTORICAL BACKGROUND 1

- Predecessor Acts And Programs 1
- Lessons Learned 3

CHAPTER 2—SEISMIC HAZARDS MAPPING ACT OF 1990 5

- Legislative History 5
- Content of the Act 5
- Chronology of the Mapping Effort 6

CHAPTER 3—OUTREACH ACTIVITIES AND INFORMATION AIDS 8

- Initial Questionnaire and the Local Government Users Advisory Group 8
- Seismic Hazard Zone Maps 9
- Seismic Hazard Mapping Bulletin 10
- Informational Brochure 11
- Guidelines for Evaluating and Mitigating Seismic Hazards 11
- Workshop on Evaluating and Mitigating Seismic Hazards 11
- Meetings and Workshops With Other Governmental Agencies 11
- Professional Meetings 12
- Seismic Hazard Evaluation Reports 12
- Public Outreach 12
- DOC Web Site and Draft Users Guide 13

CHAPTER 4—IN-DEPTH SURVEY OF FOUR LOCAL AGENCIES 14

- Purpose 14
- City of Anaheim 14
- City of Simi Valley 16
- County of Orange 18
- County of Ventura 21
- Summary, Recommendations, and Actions Taken 22

CHAPTER 5—MEETINGS WITH LOCAL GOVERNMENTS AND LESSONS LEARNED 24

- Meeting Agenda and Content 25
- Typical Questions and Comments 28

CHAPTER 6—CONCLUSIONS AND RECOMMENDATIONS 35

- General Conclusions 35
- Principal Recommendations 35

REFERENCES 37

APPENDICES

APPENDIX 1—SAMPLE ISSUE OF THE SEISMIC HAZARD MAPPING BULLETIN

APPENDIX 2—INFORMATIONAL BROCHURE: SEISMIC HAZARD ZONE MAPS

APPENDIX 3—LIST OF TECHNICAL ABSTRACTS, PAPERS AND PUBLICATIONS PRODUCED IN SUPPORT OF THE SEISMIC HAZARD MAPPING PROGRAM

APPENDIX 4—LIST OF EVAULATION REPORTS DOCUMENTING DATA AND ZONING CRITERIA USED TO PRODUCE SEISMIC HAZARD ZONE MAPS

APPENDIX 5—MEETING HANDOUTS

TABLES

Table 1. Significant milestones 7

Table 2. Members of the Local Government Users Advisory Group and list of staff who participated in the meeting 9

Table 3. Cities and counties affected by the 6 Seismic Hazard Zone maps released October 1996 (preliminary maps) and April 1997 (official maps) 24

Table 4. Cities and counties affected by the 5 Seismic Hazard Zone maps released August 1997 (preliminary maps) and February 1998 (official maps) 25

Table 5. Cities and counties affected by the 7 Seismic Hazard Zone maps released October 1997 (preliminary maps) and April 1998 (official maps) 25

Table 6. Cities and counties affected by the 12 Seismic Hazard Zone maps released August 1998 (preliminary maps) and February 1999 (official maps) 26

Table 7. Cities and counties affected by the 6 Seismic Hazard Zone maps released September 1998 (preliminary maps) and March 1999 (official maps) 27

Table 8. List of major handout sections and color key. Appendix 5 is a copy of the materials that were included in the handout booklet 28

PLATE

Sample of an Official Map of Seismic Hazard Zones ..... In Pocket

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EXECUTIVE SUMMARY

From 1996 through 1998, the Department of Conservation's (DOC) Division of Mines and Geology (DMG) developed and released 40 maps that identify areas where liquefaction and landslide hazards probably are present. These state Seismic Hazard Zone (SHZ) maps were distributed to affected cities and counties who must, in turn, require site-specific investigations prior to approving most types of development and issuing permits. This report describes, in considerable detail, the methods that DMG used to disseminate the maps and related information to more than 100 cities and four counties, and to the many consulting engineers, engineering geologists, and real estate professionals that by law, will participate in implementing various provisions of California's Seismic Hazard Mapping Act (SHMA).

A by-product of DMG's information dissemination process is that it allowed DMG's staff to improve processes for distributing information and quickly identify local implementation issues. Cities and counties also helped DMG staff to identify questions and concerns that the public and other users have about the SHZ products.

Meetings with individual cities and counties proved to be a highly effective method for educating their personnel about the zone maps and requirements of the SHMA. These meetings helped assure that hazard maps and information reached those who will implement the requirements at the local level. Although the maps portrayed information that some cities may prefer to ignore, all those agencies visited appreciated the meetings.

Key findings are:

- Mapping only a portion of a city can present the local officials with a dilemma regarding what to do in areas that are in similar settings but that have yet to be mapped.
- Outdated base maps and printed patterns used on the maps make them difficult to use. In areas where the terrain has been extensively modified, even expert map readers may have difficulty identi-fying whether properties are in or outside of the mapped hazard zones.
- Most cities and counties use one of two administrative tools—ordinances and/or permit-review procedural checklists—to assure that hazards are identified and mitigated. Some cities and counties indicated that local policies did not permit them to use maps and guidelines that were not part of their safety element. In those jurisdictions, effectiveness of the program might be hindered until the safety element is updated.
- The SHMA relies on cities and counties to determine whether the risks to life and property posed by various developments are acceptable. However, few communities have clearly defined what constitutes an "acceptable risk"—a finding that may be necessary before local building officials and planning departments can establish consistent criteria for reviewing and approving development projects.
- Although electronic distribution of information (e.g., via Internet) is increasingly effective, printed media will be required to reach those local officials that lack Internet access. Future program effectiveness requires a sustained effort to educate city and county staff and local elected officials about the Seismic Hazards Mapping Act.
- The potential exists for some cities and counties to ignore some or all of the requirements of the Seismic Hazards Mapping Act. In contrast, some cities chose to immediately implement the requirements of the Act without waiting for Official Maps to be released by the state.

- State laws and guidelines establish minimum standards of performance and prompt all cities and counties to mitigate known earthquake hazards. However, some cities and counties will be lobbied to reduce pre-existing, more stringent, requirements to the statewide minimum. Thus, the new standards may locally result in a smaller margin of safety or in some hazards not being investigated and mitigated.

Key recommendations include:

- Whenever feasible, DMG should attempt to map cities in their entirety.
- DMG should use up-to-date base maps for the official zone maps. Because it is likely that the terrain will be altered in the future, perhaps long after the maps have been released, current zone maps should be re-issued, whether or not the zones are revised, whenever new base maps become available.
- Color maps should be made available for public purchase as quickly as possible. Similarly, technical reports summarizing the data and methods used to produce the zone maps should be made available when preliminary maps are released.
- Ideally each local safety element should also consider issues related to "acceptable risk." Such an analysis should include a discussion of potential losses, costs and feasibility of mitigation, survivability, and post-disaster economic recovery. Armed with this knowledge, local decision makers can formally adopt a finding regarding the level of risk that the city or county deems acceptable. That finding can, in turn, be used by local building officials and planning departments in the permit review and approval process.
- The state's General Plan Guidelines should encourage cities and counties to consider the issue of acceptable risk and recommend ways that local agencies can minimize future implementation problems. Alternatively, the State Mining and Geology Board, possibly in concert with the Office of Planning and Research, should address these issues in future regulations and/or implementation guidelines.
- DMG's current approach of distributing maps and data in both paper and digital form should continue.
- DMG's proactive outreach—particularly the holding of individualized meetings with local agencies—warrants continued effort, as do short courses, workshops, and briefings of various professional groups. However, tools such as videos and interactive CD-ROM's should be developed to assist city and county officials to enable them to effectively and efficiently implement the SHMA.
- DOC should work with the Office of Emergency Services (OES), Federal Emergency Management Agency (FEMA), Seismic Safety Commission, State Attorney General, insurers, lenders, and other parties to encourage local compliance.

INTRODUCTION

Justification and Need for This Study

Following the 1994 Northridge Earthquake, the California Department of Conservation (DOC) and the Governor's Office of Emergency Services (OES) applied to the Federal Emergency Management Agency (FEMA) for a Mitigation Grant under the Stafford Act. The State proposed to use the funds to expedite production of 65 Seismic Hazard Zone (SHZ) maps. In mid-1995, FEMA granted funds to support production of 38 SHZ maps in Los Angeles, Orange, and Ventura c ounties. One of the conditions of the grant was that DOC conduct a "Pilot Study" to begin evaluating the effectiveness of the State's zoning program. This report summarizes the findings of the Pilot Study and describes the initial results of the State's efforts to disseminate the SHZ maps and related information.

Statement of the Problem

The purpose of the Seismic Hazards Mapping Act of 1990 (hereafter referred to as SHMA or "the Act") is to reduce future earthquake losses and facilitate informed decisions through (1) hazard identification, (2) site verification, (3) hazard mitigation, and (4) public disclosure. The Act requires the State Geologist to create "Seismic Hazard Zone maps" that depict areas subject to strong ground shaking, liquefaction, and earthquake-triggered landslides, and to provide the maps to cities, counties and state agencies for use in land-use planning and permitting. Under the Act, prior to approving most types of development, cities, counties, and state agencies must:

- Require the developer to submit a site-investigation report; the report must be completed by licensed civil engineers and/or engineering geologists and must include recommendations to mitigate any recognized hazards to a level of risk that is acceptable to the permitting agency.
- Have the report reviewed on the local lead agency's behalf, by a licensed civil engineer and/or engineering geologist.
- File a copy of the report and review comments with the State Geologist within 30 days of approval.

The Act also requires sellers of real property, or their agents, to disclose to potential buyers whether or not the property lies within a state-mapped Seismic Hazard Zone.

Thus, for the program to be effective, the Department of Conservation had to find ways to cost-effectively disseminate maps, guidelines, technical data, and related information in forms that could be understood and used by a wide variety of persons, including engineers, geologists, land-use planners, local government officials, real estate agents, and the general public.

Limitations of This Study

During this study, we met with 105 cities and 3 counties that are or will soon be affected by existing or proposed SHZ's. The primary purpose of these meetings was to deliver copies of the zone maps, briefly outline the requirements of the SHMA, and answer questions that the local officials and staff might immediately have. We made no attempt to take comprehensive notes of the events that transpired during these meetings, nor did we generate lists of all the meeting participants. However, based on these meetings, we are able to draw some general conclusions regarding current local agency capabilities, mitigation practices, and program needs with respect to seismic hazards.

As part of this study, we conducted in-depth interviews with staff in Anaheim, Simi Valley, and Orange and Ventura counties in an attempt to document the mitigation measures that were in place prior to the issuance of the SHZ maps. At the time we selected these participants, we did not know whether or not they represented the "state of the practice" with respect to mitigation of seismic hazards in the study area. After later meetings with other cities, we now suspect that the planning and building departments of the four jurisdictions that we interviewd were better informed about geologic hazards and were more apt to require mitigation before receiving our maps than were most other cities that we contacted.

Organization of This Report

Because our audience includes non-California decision makers, Chapter 1 describes the historical and legal environment that led to the development of the SHMA. This historical information provides insights regarding similar programs—some that worked well and some that did not—which helped guide development of the SHMA and influenced the content of our outreach program.

Chapter 2 briefly describes the key elements of the SHMA and related products.

Chapter 3 describes each of our outreach activities and the information aids that we developed. These activities and information aids include meetings with affected agencies, technical presentations and informational displays, technical workshops, media events, technical guidelines, an informational brochure, a program news bulletin, our web site, and, of course, the SHZ maps.

Chapter 4 describes the results of an in-depth survey of staff in four jurisdictions to document the earthquake-hazard mitigation procedures that each had in place prior to the release of our first official zone maps. The survey also solicited comments about our distribution process and products, as well as recommendations regarding additional products that cities and counties might find helpful.

Chapter 5 focuses on our meetings with local governments and related organizations, describing the general content of the meeting and listing the types of questions and comments that we typically received. These questions and comments provide valuable insight on the range of perceptions (and misperceptions) held by the various users involved in implementing the SHMA, their willingness to implement the various provisions of the SHMA, and their current technical capabilities.

Chapter 6 summarizes our principal conclusions regarding what worked well, what did not, needed improvements to specific products, and suggestions for additional outreach.

CHAPTER 1
HISTORICAL BACKGROUND

The design of the Seismic Hazard Mapping Act and our outreach program were partly based on lessons learned from earlier hazard-reduction laws and programs.

Predecessor Acts And Programs

The 1971 San Fernando earthquake caused widespread destruction in the northern metropolitan Los Angeles area. Following the earthquake, several significant laws were enacted in an attempt to minimize losses from future earthquakes. Two of these laws became landmarks for requiring that information about geologic hazards be used by cities and counties in land-use planning and permitting.

1971: SAFETY ELEMENT REQUIREMENT OF CALIFORNIA'S GENERAL PLAN LAW

Since 1937, California has required that every city and county adopt a general plan to serve as a basis for rational decisions regarding each community's long-term physical development. In 1955, the State began to require each general plan contain specific elements to address particular issues. Following the San Fernando earthquake, cities and counties were required to include information about earthquakes, landslides, and other significant hazards in the safety and seismic safety elements[1] of their general plan (Rivasplata and McKenzie, 1998, p. 9-10).

The State's Office of Planning and Research publishes and periodically revises California's General Plan Guidelines (Mintier, 1980; Mintier, 1982; Cervantes and others, 1990; Rivasplata and McKenzie, 1998). These guidelines concisely summarize legislation, case law, and other documents pertaining to the content of local general plans.

Although many adopted elements have been denigrated as being incomplete, containing outdated or inaccurate information, or having significant conceptual gaps (Smith, 1985), the requirements have been useful in educating local officials about the consequences of ignoring geologic processes that affect the local environment (Mintier and Stromberg, 1982). Through this planning process many communities have developed and adopted policies that support hazard avoidance and mitigation. However, available evidence suggests that few local agencies ever developed the permit review procedures necessary to effectively implement their adopted hazard-reduction policies (Smith, 1985, and this study).

1971: ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

The second significant 1971 action was enactment of the Alquist-Priolo Earthquake Fault Zoning Act (hereafter referred to as "A-P" or the A-P Act)[2]. The A-P Act:

- Requires the State Geologist to establish regulatory zones along faults that are "sufficiently active and well-defined."
- Mandates cities and counties to require site-specific geologic investigations prior to issuing permits for most types of development and prior to approving land subdivisions.

[1] California law permits cities and counties to structure the general plan as each sees fit as long as the required information is included. Because of the similarity in content and focus, many general plans adopted in the mid-1970's included a combined safety and seismic safety element. Subsequent amendments to the law dropped reference to the seismic safety element and expanded the scope of the safety element to include seismic hazards.

[2] Originally called the Alquist-Priolo Special Studies Zones Act, the name was changed to the Earthquake Fault Zoning Act on January 1, 1994.

- Requires cities and counties to address the A-P requirements in their general plan.
- Requires that cities and counties have a licensed geologist review and accept the site-specific investigation reports on behalf of the city or county approving the proposed project.
- Prohibits construction of structures for human occupancy over the surface trace of any active fault as identified in the site-specific investigation.
- Requires sellers of real property and their agents to disclose to potential buyers whether or not the property is located in the state-designated Earthquake Fault Zone.

Under the A-P Act, the State Mining and Geology Board must develop and adopt "policies and criteria" to guide state and local agencies in implementing the law. These policies and criteria, codified in the California Code of Regulations, Title 14, Division 2, define several key terms (e.g., "active fault" and "structure for human occupancy"). They also describe the processes for releasing new maps, investigating sites prior to development, and reviewing submitted reports by permitting agencies.

To date, the state has issued 540 official maps of Earthquake Fault Zones (EFZ), produced an explanatory document (Special Publication 42, now in its tenth edition; Hart and Bryant, 1997), an informational brochure, and numerous technical summary reports. Prior to 1997, copies of the EFZ maps were simply mailed to affected cities and counties upon release, along with an explanatory letter, a copy of Special Publication 42, and one or more "Fault Evaluation Reports" that documented the state's findings regarding the fault being zoned. The letter briefly outlined the program requirements and encouraged them to make the maps available at public counters or through local vendors. Alquist-Priolo program staff were available via phone or letter to answer questions regarding availability of the maps and interpretation of the Act's requirements.

An independent study by Reitherman and Leeds (1990) determined that, overall, the A-P program has been effective. However, they also concluded that DMG needed to more actively publicize A-P products and services and offer training courses to improve the quality of fault investigations. They also questioned the effectiveness of the real estate disclosure provisions.

1971: CALIFORNIA STRONG MOTION INSTRUMENTATION PROGRAM (CSMIP)

The third significant post-San Fernando earthquake hazard-reduction legislation established a program to install and maintain strong-motion seismographs in various structures and free-field sites throughout the state. This program is funded by a building-permit fee collected by each city and county and forwarded to the Department of Conservation. The instrumental data from CSMIP are analyzed and used to improve building codes and, thereby, structural design. Recently, these data were incorporated into the statewide probabilistic seismic hazard assessment for California (Petersen and others, 1996).

1982: LANDSLIDE HAZARD MAPPING ACT

In 1982, intense rainfall triggered thousands of landslides and debris flows in northern California, causing 24 deaths and damaging or destroying numerous homes and businesses (Smith and Hart, 1982, p. 140). In fact, landslides caused significant damage or loss of life in California during at least 17 of the 24 years from 1961 to 1983 (Rice and others, 1976; Shearer and others, 1983; Nilsen and others, 1976; Taylor and Brabb, 1982; Brabb and Taylor, 1988; Tan, 1980; Griggs and Johnson, 1983; and Smith, unpublished data).

In 1983, a landslide hazard program closely modeled after the A-P Act was proposed. However, the proposal ran afoul of a 1974 state law that requires the state to bear local implementation costs of any state-mandated program. Also, real estate lobbyists feared that landslide hazard maps would identify widespread areas as at risk and that property values would drop substantially once the infor-

mation was disclosed to potential buyers. Largely because of these issues, in spite of significant past landslide losses, the enacted version of the Landslide Hazard Identification Act (LHIA) mandated only that the State Geologist prepare landslide hazard maps at a scale suitable for land-use planning and permitting, with advice from the State Mining and Geology Board. In the LHIA, cities and counties were "encouraged," but not required to use the maps. [Significantly, state general plan guidelines (Cervantes and others, 1990) never mention the Act nor the maps, thus missing an opportunity to encourage their use.] The LHIA also lacked any requirement for real estate disclosure.

As was common in the mid-1980s, the LHIA included an automatic repeal or "sunset" provision on a specific future date unless the program was extended by the Legislature. Although the LHIA was extended once, it finally was repealed per the sunset provision on January 1, 1995.

The maps developed under this program were unlike the majority of landslide-related maps produced by state and federal agencies and private consultants. Most such maps simply identify landslide features and provide little information about the relative stability of areas underlain by bedrock. Based on SMGB recommendations, the resulting "Landslide Hazard Identification Map" series produced by DMG included a geologic map, a landslide features map, and a relative landslide susceptibility map—an interpretive map that rates the landslide susceptibility of all areas, not just areas underlain by landslide deposits. Also, because of differences in the hazard posed by debris flows and slower-moving landslides, separate debris flow susceptibility maps were produced. All of these maps were published at 1:24,000-scale (1 inch = 2,000 feet) on a U.S. Geological Survey topographic base.

Because limited funds were available to produce the landslide hazard maps and because there was no mandate that the maps be used, mapping was limited principally to areas where cities and counties requested them or agreed that they would be useful. Landslide Hazard Identification Maps for 43 areas were produced under this program.

As each set of maps was released, DMG routinely attempted to meet with city and county officials to highlight findings and answer questions. However, because city and county planners tended to change jobs every few years, local knowledge of the maps was often short-lived. For example, within six months after DMG met with Petaluma planners, all had left the city; the new staff did not know of the DMG maps and failed to mention them in their updated safety element (A. Barrows, personal communication). Significantly, although the LHIA encouraged cities and counties to use the maps in land-use planning, the 1990 General Plan Guidelines (Cervantes and others, 1990, p. 139-148) made no mention of the LHIA nor the Landslide Hazard Identification Maps. Today, based on informal discussions with many potential users, it appears that few cities, counties, consulting engineers and geologists are aware that these maps exist.

Lessons Learned

Several important lessons were learned in these programs. Among them:

- A state-legislated mandate that hazard maps be used for routine activities (e.g., permitting of land-use development) substantially increases the likelihood that they will be routinely consulted and used.
- Advisory products (any map or report that lacks a mandate that it be used) tend to be ignored or forgotten.
- Manuals that guide development of state-required planning documents need to be revised to encourage use of appropriate products.
- Technical reports that summarize the scientific basis and rationale for zoning are extremely useful to consulting geologists and local agency reviewers. These technical summaries effectively raise the minimum level of effort required to investigate proposed development sites, providing a clear set of baseline data that must be validated or invalidated.

- Peer review by licensed professionals can greatly improve the quality of site investigations.
- Peer review equips local agencies with in-house experts or consultants that understand local issues. These experts can critically review assumptions made during site investigations, identify conceptual gaps that may alter the conclusions and recommendations, and assess whether conclusions and recommendations are reasonable.

CHAPTER 2

SEISMIC HAZARDS MAPPING ACT OF 1990

Legislative History

In 1987, the State Legislature directed the Department of Insurance and the Department of Conservation to examine critical issues related to earthquake insurance. Both agencies recognized that providing improved seismic hazard information and increasing public safety would require a long-term commitment by state and local agencies, engineers, geologists, developers, lenders, and insurers. A first draft of the report to the Legislature (Holden and Real, 1990) was nearing completion when the Loma Prieta earthquake struck the San Francisco Bay Area in October 1989. Shortly thereafter, Assembly Speaker Willie Brown requested information about the preliminary findings and the draft recommendations.

The key draft finding was that a hazard identification program should map areas of ground shaking, landslides, and liquefaction, should be simple to interpret, and should contain policy guidance for local officials. The Alquist-Priolo program was cited as a viable prototype because the hazard zones were clearly identified and were combined with prescriptive measures that were easily translated by local officials into planning and building policy. Also the A-P Act distributes the cost of acquiring the site-specific information needed for mitigation on a project-by-project basis. Real estate disclosure of the map information was also a part of the recommendation (Holden and Real, 1990, p. 31-32).

Speaker Brown introduced the proposal as AB 1341. In contrast to the earlier Landslide Hazard Mapping Act, few objections were raised as the bill progressed through the Legislature, and most of these objections were quickly dealt with. Notably, by 1990, real estate disclosure was such common practice that it wasn't an issue. All sorts of facts were being disclosed, including which school district the property was in, whether the structures being sold had ever sustained fire, flood, landslide or earthquake damage, and even whether someone had died in the structure. Also, by 1990 it was clear that local agencies could legally charge for services rendered; thus mandated costs for local expert review of site-specific investigation reports could be passed on to developers as part of a development permit fee.

Content of the Act

In many ways, the resulting Seismic Hazard Mapping Act (SHMA) is similar to the Alquist-Priolo Earthquake Fault Zoning Act (A-P Act):

- The State Geologist must prepare regulatory maps and give them to cities and counties.
- Local agencies must require site-specific investigations by state-licensed civil engineers and/or engineering geologists prior to issuing permits and approving subdivisions.
- Site-specific investigation reports must be reviewed by state-licensed city or county engineers, engineering geologists, or both.
- Sellers of real property in the mapped zones, and their agents, must disclose this fact to prospective buyers.
- The State Mining and Geology Board (SMGB) and a newly created Seismic Hazard Mapping Act Advisory Committee (SHMAAC) were directed to jointly develop guidelines to help cities, counties and state agencies implement the law.

SHMA differs significantly from the A-P Act in that SHMA (1) permits cities and counties, without state review, to grant waivers under conditions specified by SMGB, and (2) does not prohibit construction in areas that are deemed hazardous by site investigations. Instead, SHMA requires that consulting civil engineers and engineering geologists develop recommendations sufficient to render any identified hazards to a level of risk that is acceptable to the city or county.

Chronology of the Mapping Effort

Initially, funding for the state mapping effort was to come from two sources: (1) local building-permit fees and (2) a rider on earthquake insurance premiums. As indicated in Table 1, most of the anticipated funding failed to materialize until after the 1994 Northridge earthquake when FEMA authorized a Mitigation Grant under the Stafford Act.

In 1991, SMGB established SHMAAC, which in turn created four subcommittees or "working groups"—Liquefaction, Slope Stability, Ground Motion, and Planning. These subcommittees, SHMAAC, and the SMGB Geohazards Committee, working with DMG staff, developed policies to guide implementation of the program. Following the mandated public review and comment period, SMGB adopted these policies as regulations. While this activity progressed, legislation was enacted that cut needed funding in half. Also, building permit fees declined due to a recession. Fiscal realities forced staff to focus on developing a prototype liquefaction hazard zone map, obtaining approval to acquire a Geographic Information System (GIS) to support the mapping program, and acquiring some key software and hardware components.

The prototype liquefaction hazard zone map covering part of San Francisco was nearing completion when the 1994 Northridge earthquake occurred. Shortly thereafter, the Office of Emergency Services (OES) contracted with DMG to quickly prepare maps showing where liquefaction and landslide hazards were likely to be present. These early maps (Real and others, 1996) focused on the area where most of the earthquake damage occurred and relied solely on existing surface geologic information. Although useful as a rapid assessment for identifying areas where mitigation grants were likely to be worthwhile, these maps were based on data that were deemed not rigorous enough for regulating land use. However, while those maps were being prepared, DMG, OES and FEMA began negotiating a larger project to expedite production of SHZ maps in the three affected counties—Los Angeles, Orange, and Ventura.

Once FEMA funding was secured in 1994, the program accelerated at almost breakneck speed. Engineering geologists, seismologists, and GIS support staff were redirected from other projects or hired. Additional GIS equipment and software were ordered and installed. Existing geologic and hydrologic maps were acquired, reviewed, and d ata gaps identified. DMG's Regional Geologic Mapping Program, working in concert with the U.S. Geological Survey, adjusted their mapping priorities to expedite mapping in areas where basic geologic data were lacking. Data conversion and processing requirements were refined. Base maps were secured, scanned, and digitized. Staff began collecting masses of borehole records and other geotechnical information from USGS and local agencies. These paper data were converted into digital databases by student assistants and staff. GIS and analytical training was arranged and held. With each mapping cycle, new lessons are learned and processes are further refined and developed.

This flurry of activity also involved SHMAAC and its three subcommittees which reviewed and endorsed the processes being used to develop the zone maps. With assistance from DMG staff, they also drafted guidelines for map use, methods of investigating zoned sites, and recommendations to assist local-agency reviewers. These draft guidelines were in turn reviewed by SMGB's Geohazards Committee. In October 1996, simultaneous with the release of the first preliminary zone maps, these draft guidelines were distributed to all cities, counties, and affected state agencies for review and comment. Based on these comments they were revised by SHMAAC, reviewed again by SMGB's Geohaz-ards Committee, adopted in March 1997 by SMGB. Only three weeks after adoption, DMG released the Guidelines as Special Publication 117 (SMGB, 1997) and also released the first six official SHZ maps.

Success of the Seismic Hazards Mapping Act hinges not only on the technical capabilities of staff, SMGB, SHMAAC, and their subcommittees and working groups—it depends on our ability to effectively communicate the information to various professionals and laypersons who must implement the program. These parties include building officials, planners, engineering geologists, and engineers who work for the more than 100 cities in Los Angeles, Orange, and Ventura counties. It includes city

Table 1. Significant milestones.

1990	Seismic Hazards Mapping Act adopted; funds for mapping provided by building permit fees and rider on earthquake insurance policies. Estimates are that $2.5 million annually will be available to support the mapping effort.
1991	Seismic Hazards Mapping Act Advisory Committee recommends development of prototype seismic hazard zone maps for areas prone to liquefaction; decides other hazards require further review of techniques before selecting methodology. State Mining and Geology Board adopts regulations that authorize these actions.
1991	Legislation repeals the program that collects earthquake insurance fees. Some of the already collected funds were forwarded to DMG, permitting acquisition of some of the computer hardware and software needed for the mapping effort.
1991-1994	A recession slows construction demand, in turn reducing income from building permits. By FY 1993-94, annual support for mapping falls to $790,000.
Jan. 1994	Northridge earthquake occurs, prompting state and federal disaster declarations.
	The prototype liquefaction hazard zone map nears completion.
Nov. 1994	FEMA/OES fund a project to rapidly identify areas that might be subject to liquefaction and earthquake-triggered landslides in 16 quadrangles in Los Angeles and Ventura counties. Cost is $500,000. This product is to be used solely for prioritizing distribution of mitigation grant moneys; supporting geotechnical data are deemed insufficient to meet state hazard zoning criteria.
May 1995	FEMA/OES agree to provide $9 million for development of 38 Seismic Hazard Zone Maps covering parts of Los Angeles, Orange, and Ventura counties.
Oct. 1996	SMGB authorizes distribution of Draft Evaluation and Mitigation Guidelines for review and comment.
	State Geologist issues first Preliminary Maps, including the original liquefaction hazard zone prototype, for review and comment.
Apr. 1997	SMGB adopts Evaluation and Mitigation Guidelines (DMG SP 117). State Geologist issues six Official Maps of Seismic Hazard Zones.

and county decisionmakers (city councils, boards of supervisors, and planning commissions) who ultimately must determine what constitutes an "acceptable risk" and require mitigation to achieve that level. It also includes the many consulting engineering geologists, civil engineers, and geotechnical engineers who must investigate and mitigate hazards in these communities. And it includes real estate professionals and property owners who, when they sell property, must inform prospective buyers that the property being sold is within a state-designated hazard zone.

CHAPTER 3

OUTREACH ACTIVITIES AND INFORMATION AIDS

Initial Questionnaire and the Local Government Users Advisory Group

Early in 1994, DMG determined that we needed to know more about the primary users of our products—local governments. We created a committee—the Local Government Users Advisory Group (LGUAG)—to advise us regarding methods of reaching key users and educating them about the SHMA and our products. We sent a letter to each city planner, building official, and engineer, alerting them to the fact that we were beginning to map their jurisdiction and asking them to complete a brief questionnaire. The questionnaire attempted to:

- Identify a principal contact person in their city.
- Determine whether their agency was aware of any geologic hazards in their jurisdiction and, if so, whether they had an ordinance in place to address those hazards. We also requested a copy of any such ordinance.
- Determine how our staff could access any geotechnical reports that the city or county might have on file.
- Determine whether those responding would be willing to assist us by serving on LGUAG.

About 60% of the questionnaires were completed and returned to us. While results were mixed, the information did help us identify points of contact to access data. However, we only obtained seven copies of ordinances in this process. Answers demonstrated that most of the respondents were not aware of geologic hazard-reduction efforts in their city. One official stated that his city was "flat" and, therefore, had no seismic hazards. Based on these responses, we initially concluded that only 10 to 15% of the cities in the region were requiring that geologic hazards be addressed when developments were proposed. [As will be discussed in Chapter 4, our later meetings with local officials suggest that most cities were requiring geologic studies prior to permitting hillside developments but that few were routinely requiring liquefaction hazard assessments prior to the release of the zone maps.] All three counties indicated that they routinely considered geologic hazards as part of the development-approval process.

About one-third of those responding expressed interest in participating on LGUAG. Thus, we had more than enough volunteers to structure a committee with representatives from a range of professions (planners, engineers, building officials, geologists), counties, and large and small cities.

Although the group only met once, the LGUAG was a useful forum. It permitted us to brief a few interested officials (Table 2) having a broad range of expertise and varying levels of familiarity with earthquake hazards about the scope of our mapping program, the SHMA, and the SMGB regulations. DMG discussed the timing of map releases, the status of the evaluation and mitigation guidelines, potential outreach efforts, and to whom maps and correspondence should be directed in each city or county. Overall, the meeting was very positive, and, with one exception, resulted in valid recommendations.

The one recommendation that was tried and found to be ineffective concerned delivery of the maps. When asked whether new maps should be sent to planning departments (the point of delivery for the Alquist-Priolo Earthquake Fault Zone maps) or someone else, respondents unanimously told us, "Whatever you do, don't do what FEMA does!" Several participants indicated that the flood zone maps were sent by FEMA to their mayor and that it sometimes took weeks or months to retrieve

Table 2. Members of the Local Government Users Advisory Group and list of DMG staff who participated in the meeting.

Catherine Bauman	Associate Planner	City and County of San Francisco
George Berg	City Engineer	City of Simi Valley
John Buzas	Planner	County of Orange
Ronald Clark	Director of Building and Safety	City of Beverly Hills
Paul Casey	Assistant to Director, Planning and Community Development	City of Santa Monica
Ben McVicker	Engineering Plan Check Officer	City of Long Beach
Natalie Meeks	Development Services Manager	City of Anaheim
David Poppler	Supervising Engineering Geologist III	County of Los Angeles
Ann Siracusa	Principal Planner	City of Los Angeles
Michael Reichle	Supervising Geologist	DMG
Ted Smith	Senior Engineering Geologist	DMG
Allan Barrows	Senior Engineering Geologist	DMG
Bea McKamey	Staff Services Analyst	DMG

them. (FEMA representatives indicate that they are required by law to send communications to the top elected official in each city and county.) The group consensus was that the maps were best sent to the city manager and county administrator because every city had a different internal structure and the administrator would know which agency should receive the maps. However, this later proved as ineffective as sending them to the top elected official.

In October 1996, DMG mailed the first six preliminary zone maps to affected city managers and county administrators. During the following three weeks, we received numerous phone calls from building officials, planners, and other interested city and county staff asking whether we had released the maps as we had planned and, if so, to whom we sent them. Obviously, like the mayors, the top administrators often didn't recognize the importance of the maps and failed to promptly transmit them to key local agency users.

LGUAG also recommended that we hold workshops to train local officials—particularly local agency reviewers—to enable them to better carry out their responsibilities. And LGUAG members commented favorably on our plans to develop a news bulletin to keep all interested parties apprised of changes in the law, the map release schedule, and short informative articles about related topics.

Seismic Hazard Zone Maps

The primary product of the Seismic Hazards Mapping Program are the SHZ maps themselves. As stated earlier, Holden and Real (1990) recommended that the maps be simple to interpret. Thus, the zone maps use a binary approach—any given property is either within or outside of a "zone of required investigation." If a property is within one of these zones, (1) a site-specific geotechnical investigation is required by law before the local agency map can legally approve most types of

development, and (2) disclosure is required when the property, whether developed or not, is sold.

After the first preliminary maps were issued for review, we received a number of comments from users. Several of these comments were incorporated into the map legends. In particular, although the law refers to the maps as showing "seismic hazard zones," the maps do not indicate areas where hazards ***are known*** to be present. Instead, the maps indicate areas where evidence suggests a ***significant likelihood*** that geological conditions conducive to the mapped hazards ***may be present*** and that ***site investigations are warranted prior to permitting new developments.*** Thus, the maps are Seismic Hazard Zone maps (per the legislation) and the zones depicted are "zones of required investigation."

Some users wanted the maps to display multiple levels of hazard. However, to keep the maps affordable, we tried to avoid showing information that would require that the maps be produced in color. Also, multiple-level hazard maps are more difficult to interpret and sometimes can be misleading. To illustrate, a map produced by a consulting firm identified areas as having very high, high, moderate, low, and very low liquefaction susceptibility. However, after reviewing the accompanying report, we determined that anticipated ground accelerations in the study area were likely to cause liquefaction in the "low susceptibility" areas. Multilevel hazard maps also are more costly to produce because substantially more groundwater and geotechnical data would be required.

DMG provides one color print and reproducible copy of the SHZ maps to each affected city and county. Color images of the maps are available at the Department of Conservation's web site (http://www.consrv.ca.gov/). Black and white copies of all preliminary and official zone maps are available to the public for the cost of reproduction and shipping from BPS Reprographics (located in San Francisco).

The current format of the SHZ maps leaves much to be desired for several reasons:

- The base maps used are 1:24,000-scale U.S. Geological Survey topographic maps. Several of the bases are more than 10 years old and do not show newer streets and graded areas. This makes the maps difficult to use for all but expert map readers and locally requires transfer of zone information to more modern bases. Also, some persons have questioned the validity of the landslide zones because they incorrectly assumed that the zones are based on the depicted outdated topography. Unfortunately, copyright restrictions preclude using up-to-date commercially available base maps on the Internet without payment of a substantial annual royalty.

- Color maps are easier to read but costly to produce. As of mid-1999, each color map costs DMG about $60 to plot. Printing the maps in quantity would lower printing costs but would incur substantial storage and shipping costs. Until mid-1999, we were not able to export the maps from our Geographic Information System (GIS) in a format that a local vendor could plot.

- Patterns on the black and white versions of the maps obscure base information.

- The GIS data files are available in a limited number of formats, without a digital base map.

- Many users need to identify whether or not individual parcels are affected by the mapped zones. The base maps do not show parcel boundaries.

With respect to parcel boundaries, upon receipt of their paper maps, San Francisco requested a digital version. Within one week, city staff imported the data into their GIS and created a map and a list showing all affected parcels. The city made a computerized version of the list of affected parcels available through the San Francisco Association of Realtors®, at various public counters, and on DOC's web site.

Seismic Hazard Mapping Bulletin

The Seismic Hazard Mapping Bulletin is a vehicle for disseminating program information to

city and county officials and other interested professionals. From October 1996 through August 1998, DMG produced eight issues of the Bulletin. A typical issue provided updated information about the schedule for producing the zone maps, lists of cities and counties affected by the various new sets of maps, pointers to DOC's web site, case histories describing how individual cities had implemented the program, and announcements of changes in the law, workshops and new products. Several issues borrowed the "Frequently Asked Questions" concept from the Internet. A sample issue of the Bulletin is included as Appendix 1. All of the Bulletins are available from DOC's web site (http://www.consrv.ca.gov/dmg/shezp/shmb/).

Informational Brochure

To help explain the program to the public, DMG created an informational brochure. In addition to including general information about the mapping program and the hazards being mapped, we addressed questions that Pilot Project participants indicated were being asked at their public counters. The brochure was updated and reprinted once; the current version is included as Appendix 2.

Guidelines for Evaluating and Mitigating Seismic Hazards

As noted earlier, the Seismic Hazards Mapping Act directs the Seismic Hazards Mapping Act Advisory Committee and the State Mining and Geology Board (SMGB) to develop and adopt guidelines to assist local and state agencies in implementing the Act. In October 1996, copies of the "Draft Guidelines for Evaluating and Mitigating Seismic Hazards in California" were sent to every city and county, affected state agencies, and other interested organizations. This draft document also was made available on the Internet. After revision, the Guidelines were adopted in March 1997. Copies of the adopted Guidelines (DMG Special Publication 117) were mailed to every city, county, and affected state agency throughout California. A hypertext version is available from http://www.consrv.ca.gov/dmg/pubs/sp/117/

Based on comments from several sources, SP 117 clearly is one of the most valuable products of the program. In California, the document is already being cited and used by professionals to investigate liquefaction hazards of existing and new hospital and school sites outside of the mapped zones (R. Sydnor, personal communication). The guidelines spurred the creation of a cooperative effort by several southern California counties, cities and consultants to develop more precise sets of recommended procedures for evaluating and mitigating liquefaction and landslide hazards (Martin and others, in press; C. Real, personal communication). Both SP 117 and the recommended procedure documents have potential application outside of California.

Workshop on Evaluating and Mitigating Seismic Hazards

As mentioned earlier, it appears that few cities were routinely requiring that liquefaction hazards be investigated and mitigated prior to the release of the new zone maps. Thus, few local agency reviewers understood the techniques that should be used in site investigations or how to interpret the results. DMG contracted with the University of California Engineering Department and the Southern California Earthquake Center to provide a three-day technical workshop or short course on the topic. Speakers included experts from the University of California (UC), University of Southern California, and DMG. About 50 city and county civil engineers and engineering geologists and 20 DMG staff attended. Almost all participants commented that the workshop was very worthwhile. UC has since held two more such workshops for consulting engineers and engineering geologists, letting government agency staff attend at a reduced rate. DMG routinely provides speakers for these workshops to describe the zone maps and explain the zoning criteria. Otherwise, the workshops are self-supporting.

Meetings and Workshops With Other Governmental Agencies

On occasion, Seismic Hazard Mapping staff met with governmental organizations to detail mapping procedures, compare products, or address earthquake hazard reduction efforts and needs. These meetings and workshops consisted of a series of short, informal papers and/or panel and roundtable discussions. These meetings included:

- Meeting of the Earthquake Affiliates, California Institute of Technology.
- Geophysics Department Seminar Series, Stanford University.
- Geological Survey Seminar Series, Menlo Park.
- Southern California Earthquake Center Workshop on Los Angeles City Earthquake Hazard Zonation.
- Seismic Hazards Mapping Conference—joint workshop by Federal Emergency Management Agency, California Department of Conservation, and Oregon Department of Geology and Mineral Industries.
- "Look Before You Build"—a series of six regional workshops on geologic hazards for local governments and consultants in the San Francisco Bay Region (see Tyler, M.B., 1996).
- Costs and Benefits of Seismic Hazards Mapping—a class seminar at Stanford University.

Professional Meetings

Part of the outreach effort includes participation in professional meetings and submittal of articles for professional publications. During the current FEMA Mitigation Grant, staff presented at least 38 technical papers at professional conferences. A list of technical abstracts and publications is included as Appendix 3. In addition, we twice spoke before local chapters of the International Conference of Building Officials, briefed the Gateway Cities Association of Planning Directors, briefed the California Building Industry Association, and provided an informational display at the Structural Engineers Association of California Annual Meeting. We also provided information to the California Association of Realtors® for publication in their monthly newsletter.

Seismic Hazard Evaluation Reports

As indicated above, cities, counties, and consulting engineers and engineering geologists have requested information regarding the data used to develop the Seismic Hazard Zone maps. Such information will be helpful to those who conduct or review site investigations. Although none have yet been released, DOC will shortly release numerous "Seismic Hazard Evaluation Reports" (see Appendix 4 for list) that summarize much of the data used and document the criteria used and findings made in creating the zone maps. In essence, each zone map will be accompanied by a Seismic Hazard Evaluation Report. A copy of the reports will be sent to each affected city and county. It is likely that these reports will be available both in printed and electronic form.

Public Outreach

In addition to producing the informational brochure, we produced informational displays for two Los Angeles City Emergency Preparedness Fairs and the California Business and Industry Show. We also developed a stand-alone display consisting of maps and pictures, using it in several press conferences. When requested, we also set up the display in city halls and county planning departments and left it for several weeks at a time.

With assistance from DOC's Public Affairs Office, four press conferences were held to announce release of new zone maps. Various staff were interviewed on television and radio. One senior staff-person appeared on a radio talk show in Ventura, and one appeared on "Which Way LA" (a local Public Broadcasting System TV talk show). Also, a TV crew taped part of one of meetings with local officials.

One of the lessons we quickly learned was that we needed to alert cities, counties, and our own staff before holding a press conference. We also learned to ask the various media to direct the public to our web site for more information. Several newspapers, radio and TV stations added links from their web sites to our own. These actions helped assure that extra staff would be available to answer the flood of telephone calls that inevitably followed every news broadcast and article.

Department of Conservation Web Site and Draft Users Guide

The DOC web site has been an effective and efficient tool for distributing information about the Seismic Hazard Zone Maps. Information available at the site include:

- Color images of the 40 Seismic Hazard Zone Maps, in various formats.
- A copy of the SHMA and associated regulations.
- A copy of the Guidelines for Evaluating and Mitigation Seismic Hazards (DMG Special Publication 117).
- Copies of the Seismic Hazard Mapping Bulletin.
- A fact sheet that provides a brief overview of the Seismic Hazards Mapping Program.
- Information describing the criteria used for developing the zone maps.
- A list of available SHMP maps and other products.
- A draft Users Guide.

The initial Users Guide was patterned after DMG's Special Publication 42 *Fault Rupture Hazard Zones in California*. When DOC first created its web site, the draft incomplete version of the Users Guide was accidentally posted. Within days, the Association of Bay Area Governments and others began touting it as containing "the most understandable description of liquefaction hazards available." It has remained on the web, although still incomplete, and has been updated to refer users to new zone maps as they become available. Plans are to complete and publish the Users Guide in the near future.

CHAPTER 4

IN-DEPTH SURVEY OF FOUR LOCAL AGENCIES

Purpose

In late 1996, DMG invited two cities (Simi Valley and Anaheim) and two counties (Orange and Ventura) to participate in a pilot project. The purpose of this project was to (1) identify tasks that the state could undertake to improve the effectiveness of the SHMA at the local level and (2) establish a baseline record for later use in evaluating program effectiveness. Although the initial level of enthusiasm varied, ranging from skepticism to eagerness, all accepted the invitation.

In early 1997, baseline interviews were held with all participating agencies. In these interviews, we sought to document the types of problems that cities and counties experienced during and following release of the first six preliminary (October 1996) and official (April 7, 1997) SHZ maps and SMGB's Guidelines for Evaluating and Mitigating Seismic Hazards in California (1997) . DMG routinely sends three paper copies of each preliminary map and one reproducible copy of each official map that affects a jurisdiction. When the first six maps were released, the maps and documents were sent to city managers and county administrators by regular mail, dispatched one or two days before the formal release date. [Note: Based on comments received after the first map release, newly released maps are now sent to a city- or county-designated staff person—usually in the planning or building and safety department.]

City of Anaheim

Local Setting

Anaheim is situated along the Santa Ana River and covers approximately 50 square miles of Orange County. The city experienced exponential growth during the 1950s and 1960s following the opening of Disneyland, increasing in size from 5,000 to its present day population approaching 297,000. The safety element of the city's 1987 general plan describes the city as "highly urbanized flat land area and a rapidly developing hill and canyon area." Anaheim is affected by two SHZ maps—the Newport Beach and Anaheim quadrangles.

Content of Existing Safety Element

Anaheim's general plan was last revised in 1987. The safety element cites fault-rupture, ground shaking, landsliding, liquefaction, erosion, and flooding as hazards present in the area. Included maps depict fault locations, earthquake epicenters, potentially liquefiable soils, flood areas, hazardous facilities (e.g., pipelines and transportation corridors), emergency facilities and evacuation routes. One fault, part of the Whittier-Elsinor Fault Zone, is cited as having been zoned under the Alquist-Priolo Earthquake Fault Zoning Act. [Interestingly, the element only identifies two narrow stream channels in the western-most part of Anaheim as potential liquefaction areas; DMG's new zone maps included a much larger region.]

The safety element establishes a goal of minimizing "the risk to life and property through the identification of hazardous areas, establishment of proper design criteria, and provision for public information." Policies associated with the goal are 1) mapping of existing faults, landslide areas, and other geologically unstable conditions, 2) analyzing existing earth and geologic data, and 3) mitigating potential disaster through land use and development standards.

Participants in the Process

DMG outreach staff visited the Anaheim to conduct the interview on April 10, 1997, following release of the official maps and guidelines. City Building Official, Julie King, and Zoning Division Manager, Greg Hastings participated in the interview.

Status of Safety Element

Presently, Anaheim has no plans to revise the element as there is no perceived need to do so.

Existing Permit Review Process

When a proposed subdivision (tentative tract) map is submitted for city approval, the zoning staff send copies to all departments for an in-house review. The soils information is reviewed by public works, which sends its comments to the planning commission. After all comments are received, the planning commission either approves or denies the subdivision proposal.

If the planning commission approves the subdivision, a geotechnical engineering report is required before the map is recorded. Then the final map goes to the city council for approval. Following approval by the council, permits are issued and construction can begin.

Comments on Program Implementation and SHZ Map and Guideline Release

Anaheim staff made the following comments that pertain to both the preliminary and official maps and the guidelines:

- The impact of the preliminary map release was inconsequential, since there were few or no public inquiries. Other than the time spent by staff to review the maps, there were no impacts.
- For release of the official maps, the building official received a fax advising her that the guidelines would be sent by overnight mail, but they never arrived. (DMG staff provided the city with a copy during the interview.) In Anaheim, grading permits are issued by the Department of Public Works, so mailing to the city engineer (who is in another city agency) is not sufficient.
- There was not enough lead time to adequately prepare staff for public inquiries following receipt of the official maps and guidelines.
- DMG needs to get more information out to real estate agents and developers. They want yes or no answers. They want to know whether a given property is in or out of the zone. Real estate agents ask city staff for written confirmation for their disclosures. Anaheim staff wanted to know whether there is a model for such a statement.
- Much of Anaheim has been developed over the last 20-25 years. Those new streets are not shown on the maps. Also, the maps are not easy to read, and establishing the status of borderline properties will be difficult. The FEMA flood plain maps are an example of the level of detail needed.
- The maps do not cover all of Anaheim. This piecemeal availability creates additional uncertainty about implementation. City staff indicate that they need all of their city mapped before they can implement the Act effectively.
- Anaheim believes that sending site investigation reports to the state will be a bureaucratic nightmare. The volume of the reports will become unmanageable.
- The state should set standards rather than leave enforcement options to local governments. The guidelines are too ambiguous and can be applied differently by different jurisdictions. Anaheim staff are unclear regarding their legal authority to require site-investigations and mitigation.
- Anaheim officials are officers in Orange Empire Chapter of the International Conference of Building Officials and the Planning Director's Association. These professional organizations are good vehicles for reaching local governments.
- Workshops that provide an overview of maps and discuss ways to convert the Act into implementable policies would be helpful.

Geographic Information System (GIS)

Anaheim's ArcInfo® GIS was not yet fully operational. City staff were not yet able to incorporate

the landslide and liquefaction zones into their system.

City of Simi Valley

Local Setting

Simi Valley, located in eastern Ventura County, has a population of almost 104,000. Growth has more than doubled the city's population since 1975. Simi Valley sustained heavy damage during the 1994 Northridge earthquake, mostly from liquefaction induced by intense ground shaking. The city is mostly flat, except on the outskirts—an area that is largely undeveloped at present.

Content of Existing Safety Element

Simi Valley adopted its current safety element in 1992. The element contains more than eight pages of clear and specific policies that require geologic and related hazards to be addressed and mitigated. For example, the first of these policies states, "The development review process shall ensure that all projects comply with federal, state, and local health, safety, and environmental laws."[3] Other policies address local adoption of technical guidelines, use of licensed professionals as reviewers, and issues specific to various types of hazards. The plan's technical appendix includes 22 maps and figures identifying areas where landslides, debris flows, liquefaction, amplified ground shaking, expansive soils, flooding, dam inundation, seiches, urban fires, etc., may occur. More than 90 pages of text explain the maps, discuss the potential effects and the likely impact on specific types of structures.

Participants in the Process

DMG outreach staff visited the Simi Valley to conduct the interview on February 6, 1997, following release of the preliminary maps and guidelines. Assistant City Manager Laura Herron arranged the meeting. Also present were Michael Kuhn, Senior Planner; Gaddis Farmer, Building Official and Deputy Director of the Department of Environmental Services; George Berg, City Engineer and Deputy Director of Public Works; and James Thorsen, Senior Engineer.

Simi Valley's Northridge Earthquake Experience

Community awareness of the potential for earthquakes appears to have been high prior to the 1994 Northridge earthquake. Many Simi Valley residents had earthquake insurance. For about 35 years, Simi Valley has been requiring builders to implement a number of other construction improvements that are above Uniform Building Code (UCB) minimums. Strengthened foundations (post-tension slabs) to address expansive soil problems were required for 8 or 10 years prior to the Northridge earthquake—these measures helped minimize liquefaction losses in some areas. However, in spite of these precautions, numerous older homes, roadways, and pipelines were damaged in Simi Valley during the 1994 Northridge earthquake. Barrows and others (1994) determined that most of this damage was attributed to differential settlement and liquefaction in poor-quality fills that had been placed adjacent to streams prior to the city's imposition of more-rigid grading and construction standards. In fact, most of the damage occurred in areas identified in the 1992 safety element as being subject to liquefaction.

Some of the public had criticized Simi Valley's more-stringent review and mitigation requirements prior to the Northridge earthquake. However, following the earthquake, many of these critics returned to thank city officials and staff because they understood that these measures kept their homes from sustaining extensive damage.

After the Northridge earthquake, Simi Valley became an advocate for many of its residents. At first, insurers refused to pay for bringing repaired structures up to current code. City staff steadfastly refused to issue permits for repairs unless present codes would be met and insurers eventually covered the cost of building to current code. Simi Valley required an engineering evaluation of damaged

[3] This carefully worded statement is a good illustration of an open-ended policy that permits the city to immediately use the new Seismic Hazard Zone maps. Through its inclusion, employees are automatically empowered to impose new safety-related state mandates without awaiting amendments to outdated local general plans.

buildings and forced general contractors to demonstrate compliance with existing codes.

Many buildings in Simi Valley that were damaged by liquefaction also are in the 100-year flood zone. For those properties, FEMA required the owner to elevate the structure when damage exceeded 50% of value. Many people saw this as double injury, having first sustained damage from the Northridge earthquake and subsequently having to bear the additional costs due to FEMA's flood-hazard mitigation requirement. In one instance, a dispute over the value of the property delayed repair three years.

Prior to the Northridge earthquake, Simi Valley had drafted a new set of development guidelines. After the earthquake, getting the new guidelines approved was easy because it was clear to just about everyone that the need for code improvements was real.

Public interest in reducing seismic hazards has increased following the earthquake. In essence, most of the public believes that cities and counties aren't doing enough—that the next earthquake will cause similar damage to occur.

Status of the Safety Element

At the time of the interview, Simi Valley planned to amend their safety element in 1997. The preliminary zone maps released by DMG were consistent with the maps that Simi Valley currently used for permit review and approval. The revised safety element will incorporate DMG's seismic hazard zone maps by reference. Revision of the safety element will effectively adopt the SHZ maps and guidelines for local use.

Existing Permit Review Process

Simi Valley developed "Guidelines for Geotechnical and Geological Studies" in late-1993. These guidelines took on a special urgency following the January 1994 Northridge earthquake and were adopted in May 1994. The State Mining and Geology Board used the Simi Valley guidelines as a reference during development of the "Guidelines for Evaluating and Mitigating Seismic Hazards in California."

Comments on Program Implementation and SHZ Map and Guideline Release

- The city had no problems as a result of the release of the preliminary seismic hazard maps. The maps did not require a big adjustment, since Simi Valley is already essentially implementing the SHMA. The city's existing programs already address the state requirements for the most part. City guidelines, adopted in 1994, are very similar to the guidelines adopted by SMGB in 1997.

- DMG's briefings of Simi Valley staff were exceptionally helpful, as was the advance warning that DOC was holding a press conference. Because Simi Valley residents experienced the Northridge earthquake, many responded to the press releases or television coverage by contacting the city. The state SHZ maps are kept at the planning department counter where they can be viewed by the public, if requested.

- Simi Valley has taken the time to educate the professionals who are operating within the Simi Valley. Site investigations already meet the minimum requirements of the SHMA.

- Counter service was not significantly impacted. Following DOC's press conference, Simi Valley had questions and comments from builders and homeowners, such as:

    - We're already expected to do a lot more than anyone else. Does this (new program) mean the restrictions will be even tougher?
    - How much will this (new program) cost?
    - Will my insurance rates increase?
    - I won't be able to sell my house—property values will decline.

- In general, there is great public awareness of earthquake hazards within Simi Valley. The state, county, and city need to continue educating the public about these hazards and how they can be mitigated. Descriptions of

liquefaction, lateral spreading, slope deformation, and seismic settling in lay terms with photographs of actual failures are useful in explaining the damage that can occur.

- Simi Valley would like to have more copies of the preliminary maps.
- About five percent of city residents speak Spanish only. Written material in Spanish would be helpful.
- Simi Valley staff need a better understanding of seismic hazards to enable them to explain safety issues to the public. A video program that explains basic geologic terms and general requirements of the SHMA would be helpful.
- DMG needs to transmit maps and information to real estate agents, perhaps through local real estate organizations.
- Press coverage caused some residents to overreact. Simi Valley is advising people that there are no new dangers here—that the previously city knew about that hazards and routinely required them to be investigated and mitigated prior to receiving the SHZ maps.
- Simi Valley staff and the public find it difficult to identify many properties because of the outdated base map. The city doubled in size after the 1969 base map was prepared and many existing streets are not shown.
- Simi Valley complemented DMG staff on the accuracy of the maps.
- Simi Valley has always had stringent land-use requirements to protect the public from known natural hazards; the state guidelines will aid the city by documenting standards and procedures that are more stringent than those commonly used elsewhere, thereby helping the city to justify a higher standard of performance.
- Geotechnical professionals will have consistent rules to work with.
- Simi Valley would like to have reproducible copies of the preliminary maps and more copies of handouts.

Geographic Information System

Simi Valley is developing an ArcInfo® geographic information system. At the time of the interview, it was expected to be operational in 1997.

County of Orange

Local Setting

Orange County is located on the coast between California's two most-populated counties—Los Angeles and San Diego. The county covers 484 square miles and has a population of about 2.7 million. There are 31 incorporated cities within the county. Few cities in Orange County rely on county staff for technical services such as grading and construction review.

Participants in the Process

DMG outreach staff conducted the interview on January 21, 1997, following release of the preliminary maps and guidelines. Arrangements were made through John Buzas, the Planning Director. County Geologist Johnny Earnest was also present.

Content of Existing Safety Element

The safety element of the county's general plan was last revised in 1987. The plan inventories flood and seismic hazards, including ground shaking, ground displacement, subsidence, and uplift. Ground failure (lurch cracking, lateral spreading, slope failure) liquefaction, and water waves (tsunamis and seiches) are cited as secondary hazards. The report includes maps showing areas where liquefaction is likely to occur given earthquakes on the Newport-Inglewood and the San Andreas Faults. Adopted policies call for establishing development standards to ensure proper design and location of structures and to provide technical and policy information regarding geologic and seismic hazards through the county's Buyer Notification Program.

Status of the Safety Element

No general plan revision is anticipated in the foreseeable future. The county will incorporate state guidelines and maps into existing decision-making processes by reference; thus adequate mechanisms exist to implement the SHMA without a general plan update.

Existing Permit Review Process

Orange County has a number of geologists and civil engineers who enforce the grading code and review site investigations. County staff do not believe that their workload will change significantly once the maps and guidelines become official.

Comments on Program Implementation and SHZ Map and Guideline Release

The following comments pertain to both the preliminary maps and the guidelines:

- For Orange County, the preliminary map release was a not an issue. The staff geologist talked to only two people who had questions. Release of the official maps may produce different results.
- The DMG briefing of county staff was very helpful.
- In the future, DMG should provide a bulletin or brochure for the public that presents an overview and answers frequently asked questions, including:
  - What are seismic hazards?
  - What happens during an earthquake?
  - Why is this information important to the public?
- Orange County foresees no significant impacts on its operations once the maps and guidelines become official.
- There has been no change in the way counter service is provided since the preliminary maps have been in existence. The current grading and excavation code is not too different from the requirements imposed by the SHMA.
- Existing policies can be implemented with present tools. The present building code and the grading and excavating code address liquefaction and landslide hazards.
- Most public inquiries will be from real estate people who need to disclose whether property is in a Seismic Hazard Zone.
- We expect to be inundated with phone calls and information requests when the official maps are released. DMG can help by directing the public to sources other than the county for much of the information. DMG also can help cities and counties provide correct and consistent information by providing clear answers to the 20 or 25 most frequently asked questions, such as:
  - How can I get maps?
  - How can I get guidelines?
  - What are the maps intended to do?
  - Where can I review the data on which the maps are based?
  - Does this mean I can't sell my house until I fix it up?
  - Will my insurance rates go up?
- Cities and counties need to have the maps **PRIOR** to the release date in order to respond effectively to the public.
- Make answers to frequently asked questions available on the Internet.
- Provide reproducible copies (on mylar) of the maps to local jurisdictions.
- Develop a poster containing a standard notice that can be posted with the maps in city and county offices.
- Model ordinances would not be helpful to Orange County.
- The county would be happy to use DMG's map display to inform the public about the

maps prior to and immediately following release of the preliminary and official maps.

- A video would be helpful. In particular, it should explain each hazard and provide details on how to obtain maps, guidelines, other detailed information.

- If DMG produces a CD-ROM, it should provide multiple levels of information. Explain basic terms (e.g., faulting, landslides, liquefaction). Include everything that is on the web site—maps, guidelines, user's guide, in-depth discussion of what the maps mean and how they are intended to be used.

- Any user's guide created needs to be more user friendly than the Alquist-Priolo program's Special Publication 42 (Hart and Bryant, 1997). SP 42 is overly technical. An effective user's guide would contain guidelines, photos and a discussion of hazards and risks, details on mitigation, cost of mitigation, etc.

- As for printed materials, large, colorful, attention-getting posters distributed to cities, counties, state buildings, etc., would be effective. Nontechnical pamphlets on liquefaction, retrofitting, or other topics are needed for distribution to the public.

- A newsletter could contain more "folksy" topical discussions than the current Seismic Hazard Mapping Bulletin (SHMB). It would serve as a clearinghouse of information between the implementing jurisdictions.

- SHMB could contain technical articles to aid cities and counties in implementing the requirements of the SHMA. This possibly could be incorporated in the previously mentioned newsletter. DMG should make reproducible copies of the SHMB or newsletter available so that local agencies can print more copies and hand it out to the public.

- Orange County staff like the idea of technical workshops and short courses. There is a need for geotechnical information in the building, planning and transportation agencies in the county. The same information would be useful to consultants and builders.

- Other workshops might be needed to inform regional agencies, special districts, and state agencies about the maps, the Seismic Hazards Mapping Act, and related products.

- The SHZ maps may raise a number of concerns. For example, will the fact that property is in a zone affect one's ability to get insurance and loans? Also, some people may fear that special interest groups will try to limit development based on the maps.

- The state should be aware that there are many obstacles that will make it difficult to distribute information to local officials. Many local agencies lack internal computer networks and Internet connections. Local agencies often find it difficult to justify Internet and internal network connections for staff geologists, engineers, building officials, or other personnel that DMG needs to reach.

- California Geology (DMG's bimonthly magazine) is a good tool—publish more information there!

- DMG should develop a contact list for each jurisdiction and keep it updated so that cities and counties can begin networking with each other.

- Orange County's surveyor frequently updates their GIS information. It is possible that DMG could obtain updated parcel and other map information via electronic transfer from the surveyor.

- Consistent with the requirements of the SHMA, Orange County probably will not require investigations for single-family dwellings unless they are part of a larger development. Counties have a hard time convincing community leaders that more stringent regulations are needed than state law requires.

- Questions from the real estate industry probably will have the greatest impact on our workload. Who can we divert those questions to?

Geographic Information System

Orange County has a fully functioning Intergraph® geographic information system. It is the only county in California in which one may file a digital application to subdivide land.

County of Ventura

Local Setting

Ventura County is located on the coast immediately west of Los Angeles County. Ventura County covers 1,875 square miles and has a population of about 700,000. There are ten incorporated cities within the county, all located in the southern half.

Participants in the Process

DMG outreach staff conducted the interview on February 5, 1997, following release of the preliminary maps and guidelines. Arrangements were made through the Planning Director, Keith Turner. Jim Otusa, a consulting geologist retained by the county, was also present.

Content of Existing Safety Element

Ventura County's safety element was updated in 1988. However, it was not available for review. The 1974 seismic safety element recommends that each local entity (we presume they mean each of the cities and the county, although counties do not have jurisdiction over lands within incorporated cities in California) advise residents about local hazards and require appropriate site investigation prior to permitting development. The element acknowledges fault rupture, ground shaking, liquefaction, landslides, beach erosion, and subsidence as geologic hazards that affect the county.

Status of the Safety Element

At the time of the interview, the county was revising its safety element.

Comments on Program Implementation and SHZ Map and Guideline Release

- Although the preliminary maps (sent to the county administrator) reached the planning/community services and public works agencies, the state should send the maps directly to one or both of those agencies. County staff suggested that the state develop a cover letter to be sent to the county administrator or city manager, planning or other agency directors, advising them of the map release and to whom the maps of their jurisdiction were sent.

- When asked whether the DMG briefing of county staff prior to the release of the preliminary maps was helpful, the response was an emphatic "Yes!" County staff indicated they would not have known about it otherwise. They advised DMG that it might not be necessary to revisit cities and counties when additional maps are released unless some time (e.g., two years) has elapsed. After two years or more, it's probably a good idea to revisit the agency.

- Ventura County staff did not receive a copy of the draft guidelines by mail—their copy apparently never made it out of the County Administrator's office. Until our interview, the only copy they had was an outdated draft that DMG delivered during the pre-release briefing.

- Although staff already refer to the preliminary zone maps, they still use the existing general plan maps for permit review because they are the maps that Ventura County has adopted for permit review and approval. DMG maps indicate areas that failed during the Northridge earthquake, which is useful.

- When asked whether the preliminary maps required a change in the way that the Ventura County provides counter service, the answer was "No—the area affected by these two maps is too small to cause much impact."

- The SHZ maps provide new up-to-date information that will supplement existing geohazard data. A process is already in place that will use the additional information to update the general plan.

- County staff do not foresee any significant change in workload once the maps become official. However, they realize that they might receive a significant number of inquiries regarding the real estate disclosure requirements. To aid in this process, staff might be able to add a field to the assessor's computerized parcel information database. However, at this time the county has no plans to do so.

- Interactive CD-ROMs and videos could be effective tools in educating staff and the public about the maps and requirements of the SHMA. The county also might be interested in borrowing DMG's map display.

- To heighten awareness of the maps, DMG might seek a resolution from the state legislature, county board of supervisors, or city council. DMG should also attempt to have the maps and related materials placed in all county and city libraries.

- Ventura County will sell copies of the zone maps, but they also liked the idea of letting a local vendor sell them.

- The user's guide should be comprehensive. The frequently asked questions in the Seismic Hazard Mapping Bulletin enable them to better answer many of those that they receive.

- County staff like the idea of communicating up-to-date digital information between GIS systems. One problem with capturing new information is deciding how to use it.

Geographic Information System

At the time of the interview, Ventura County had a functioning ArcInfo® geographic information system although the digital base map was only 80% complete.

Summary, Recommendations and Actions Taken

The following recommendations for improvements in DMG operations and additional products are based on the information presented above. As indicated below, several of these recommendations already have been enacted.

- ***Continue Proactive Outreach***

  It is clear from interviews that the individualized visits to local governments is an important outreach tool and should be continued and refined. Although some cities and counties will find the information on the maps to be unpleasant news, their staff almost universally welcome the advance warning and personalized attention that the individual briefings provide. However, DMG presentations should avoid creating a perception that the state is imposing another bureaucratic process on local governments. *[This recommendation has already been implemented.]*

- ***Improve Map Distribution Processes***

  The method used to deliver the first set of preliminary and official maps and guidelines was ineffective. The mailing labels purchased from non-DMG sources are not always current. DMG should establish an in-house mailing list and make ongoing efforts to keep it current. DMG should also determine a contact in each jurisdiction who will coordinate local distribution of time-sensitive materials. *[These recommendations have already been implemented.]*

- ***Hold Workshops***

  All respondents indicated that workshops and short courses were greatly needed. In particular, these workshops should educate practitioners (engineers, geologists, local building officials, and planners) who are directly involved in conducting site investigations and reviewing the resulting reports. Separate workshops should be held to educate real estate agents. [*As noted in Chapter 3, a short-course on identifying and mitigating seismic hazards has already been developed and presented three times—twice in southern California and once in the San Francisco Bay Area.*]

- ***User's Guide***

  A users guide will be a valuable information tool for local governments. The guide must be user-friendly and attractive. Ideally, it will largely be a nontechnical document in a format that can be used to educate the public. It should include descriptions and photographs, discussion of the hazard mapped, information about mitigation techniques and costs, short case histories describing how cities and counties have implemented various aspects of the program, and suggestions to facilitate cost-effective mitigation. *[The draft Users Guide, currently available on the Internet, will be revised, added to, and published in the near future, using some of the insights gained in these four local agency interviews and other suggestions received during our outreach effort.]*

- ***Other Educational Tools***

  Educational tools such as map displays, newsletters or bulletins, pamphlets, an interactive CD-ROM, and videos might be effective in reaching some constituents. Although DMG has made great strides in posting maps and other information on the Internet, many city and county staff lack Internet access. Therefore, DMG needs to continue efforts to produce and distribute useful printed materials. Some materials (e.g., a pamphlet that describes the program and how to obtain maps) should be made available in Spanish. *[To date, DMG has produced eight issues of the Seismic Hazard Mapping Bulletin and a pamphlet. All these materials are available on the Internet. Current plans are to make the pamphlet available in one or more standard word-processing formats so that cities and counties can add their own local contact addresses and tailor the information to reflect local requirements and procedures. Other recommendations may be implemented in the near future, if funding is available.]*

CHAPTER 5

MEETINGS WITH LOCAL GOVERNMENTS AND LESSONS LEARNED

In the 1980s, DMG began meeting with cities and counties prior to developing hazard and mineral resource maps. These early project meetings introduced cities and counties to our efforts, aided in obtaining access to local data, and provided communities with ample time to consider ways the resulting maps and reports could be used. In most cases, as earlier mentioned, the areas selected for hazard analysis had been in locations where local agencies desired the data. Usually the number of interested agencies were few (e.g., one county and one or two cities). Thus, "personal" attention often was easily accommodated.

In this effort, we were faced with an enormous task of communicating the results of our studies to more than 100 cities in three counties. Complicating this outreach was the fact that the final products would not be issued on a jurisdiction by jurisdiction basis, but in four sets of 7.5-minute quadrangle format issued on different dates. Thus, there were cases in which some cities were given maps that covered only part of their jurisdiction.

The dates that individual maps were issued depended mostly on how quickly the data could be gathered and analyzed. File data from previous city/county-state cooperative studies helped the expedite release of four maps—two in Orange County and two in Ventura County. A fifth map in Los Angeles County was added primarily as a prototype for the landslide hazard zoning effort.

Initially we considered adopting a print and mail approach similar to that routinely for distributing the Alquist-Priolo maps. We also considered holding regional workshops prior to the various major releases. Because our initial questionnaire suggested that few cities and counties were routinely requiring pre-development geologic site investigations and mitigation, we decided that the print and mail approach would be ineffective. As for workshops, we slowly realized that it was unlikely that we would reach most or all city and county staff who would or should be involved in enforcing provisions of the SHMA. Therefore, we decided that it was essential to meet individually with each city and county to discuss, answer questions about, and deliver copies of the preliminary maps, guidelines, copies of the Act and associated regulations, and related information.

Our first set of six maps covered four counties and 20 cities (Table 3). Based on input from LGUAG, our initial point of contact in each city and county was the city manager or county administrator. We briefly explained that we wanted to meet with them and selected staff to discuss some new

Table 3. Cities and counties affected by the six SHZ maps released in October 1996 (preliminary maps) and April 1997 (official maps).

COUNTIES	CITIES		
Los Angeles	Anaheim	Huntington Beach	Placentia
Orange	Buena Park	Los Angeles	San Francisco
San Francisco	Costa Mesa	Malibu	Santa Ana
Ventura	Cypress	Moorpark	Santa Monica
	Fountain Valley	Newport Beach	Simi Valley
	Fullerton	Orange	Stanton
	Garden Grove		Westminster

regulatory maps that would cover all or part of their community. They often delegated responsibility for the meeting to another person. Largely because few people knew much about the SHZ maps and the Act, it took an inordinate amount of time (about 6 weeks) to arrange the first set of meetings. While most cities had us meet with planners, building officials, engineers, emergency officials, lawyers, and various administrators, two cities each had us meet with only one person (one a city planner and one the city emergency response official). In contrast, we met with 17 staff from Los Angeles County.

The extensive newspaper and television coverage of the release of our first set of maps alerted cities that they would be receiving similar maps for their jurisdictions in the near future. That made it easier for us to schedule subsequent meetings with cities that were affected by maps later released (Tables 4 though 7). Also, to improve the likelihood that we would brief the staff that needed to know about the maps and requirements, we began routinely advising city managers that, at a minimum, we needed to meet with their planning and building officials and any other staff involved in approving land use, grading, and construction proposals.

Some cities were affected by multiple maps that were released at different times. When a city with which we had already met was affected by one or more new maps, we routinely called them and gave them the option of scheduling another meeting or having us send them an advance copy of any new maps. About half requested another meeting. Interestingly, we found that about half of these additional meetings had more local attendees than had the first meeting. Some, but not all, of these additional meetings focused on specific problems that the city was having in interpreting the Act, the guidelines, or in reviewing site-investigation reports.

Meeting Agenda and Content

The stated objectives of each local meeting were to:

- Establish an open line of communications between the city (or county) and the state.
- Deliver an advance copy of the maps being released for review and comment and describe how the official maps would be released.

Table 4. Cities and counties affected by the five SHZ maps released in August 1997 (preliminary maps) and February (oficial maps).

COUNTIES	CITIES		
Los Angeles Orange	Agoura Hills Calabasas	Hidden Hills Los Angeles	Santa Clarita Simi Valley

Table 5. Cities and counties affected by the seven SHZ maps released in October 1997 (preliminary maps) and April 1998 (official maps). Two of these seven maps were revised versions of previously released maps.

COUNTIES	CITIES		
Los Angeles Orange	Anaheim Brea Buena Park Costa Mesa Diamond Bar Fullerton Industry	Irvine La Habra La Habra Heights La Mirada Laguna Beach Newport Beach	Orange Placentia Santa Ana Tustin Villa Park Whittier Yorba Linda

Table 6. Cities and counties affected by the 12 Seismic Hazard Zone maps released August 1998 (preliminary maps) and March 1999 (official maps).

COUNTIES	CITIES		
Los Angeles	Arcadia	Glendale	Paramount
Orange	Artesia	Glendora	Pasadena
	Azusa	Hawaiian Gardens	Pico Rivera
	Baldwin Park	Huntington Beach	Pomona
	Bell	Huntington Park	Rosemead
	Bell Gardens	Industry	San Dimas
	Bellflower	Irwindale	San Fernando
	Buena Park	La Canada-Flintridge	San Gabriel
	Burbank	La Mirada	Santa Clarita
	Cerritos	La Puente	Santa Fe Springs
	Commerce	La Verne	Seal Beach
	Compton	Lakewood	South El Monte
	Covina	Long Beach	South gate
	Cudahy	Los Alamitos	Stanton
	Cypress	Los Angeles	Temple City
	Diamond Bar	Lynwood	Vernon
	Downey	Maywood	Walnut
	Duarte	Monrovia	West Covina
	El Monte	Montebello	Westminster
	Garden Grove	Monterey Park	Whittier
		Norwalk	

- Provide information on the requirements of the Seismic Hazards Mapping Act.
- Identify a primary contact within the city (or county) to whom maps and official correspondence would be directed.
- Provide information about additional resources available from DMG.

This list of objectives served as a rough agenda for each meeting. However, because the interests, knowledge, and expertise varied from city to city, we often spontaneously rearranged the order in which the topics were addressed. Meetings typically lasted 35 to 75 minutes, generally correlating with the number of participants. Meetings with three or fewer staff typically lasted 35 to 45 minutes. If seven or more were involved, we typically spent an hour or more.

We had several "attention getters." First, the color maps themselves inevitably prompted participants to determine whether their home or that of a fellow employee was in or out of the mapped zones and how much of the city was affected. Once those facts were established, some cities began discussing the potential effect that the maps would have on newly proposed developments for which permits had already been or shortly would be requested.

In general, after these initial map checks, we directed their attention to our second "attention-getter"—a collection of handout materials (Appendix 5) that were three-hole punched and assembled in a clear-covered binder. For ease of reference, each major section of this bound material was printed on a different color paper (Table 8). First we directed their attention to the list of meeting objectives. Next we briefly described the history of the SHMA, starting with the 1971 San Fernando earth-

quake and the three key pieces of legislation that followed (see Chapter 1). This historical overview gave us the opportunity to emphasize that Alquist-Priolo maps only address the hazard of fault rupture, whereas the new program addresses liquefaction, earthquake-triggered landslides and, potentially, other earthquake hazards. It also allowed us to explain how the building-permit fees that cities and counties collect are being used in California's Strong-Motion Instrumentation and Seismic Hazard Mapping Programs.

Next we referred them to the color pictures on pages 5 through 8 of the draft Users Guide. These pictures were extremely useful in illustrating the types of damage that can result when liquefaction, lateral spreading, and landsliding occurs. We pointed out that lateral spreading occurs along stream channels and stated that site-investigation reports near such channels should address the hazard and likely would be more costly to mitigate than liquefaction hazards in flat-lying areas away from such channels. We talked about the conditions (loose sandy soils and shallow ground water) required for liquefaction to occur. We explained the basis for the liquefaction and landslide zones shown on our maps and indicated that summary reports documenting the data and criteria used would be forthcoming. We also advised that following the Northridge earthquake, when liquefaction caused damage, insurers paid out an average of $70,000 per home (E. Baum, personal communication). Next we told them that for about $3,000, a typical slab foundation could be strengthened enough to reduce those losses to $10,000 to $15,000 (D. Hsu and T.L. Youd, personal communication). This gave us the opportunity to stress the goal of the program—"Build Safer Homes and Offices"—and long-term potential economic benefits (both direct to the homeowner and indirect to the community).

Next we addressed the site-investigation requirements, applicability to various types of projects, and city and county roles in requiring and reviewing site-investigation reports. We directed meeting participants to the SP 117 guidelines for information about site-investigation and mitigation techniques. We typically discussed the concept of "acceptable risk" and the role that the safety element of the general plan could play in determining what level of risk the city or county considers acceptable (assuming the element were updated and expanded to address the topic).

Table 7. Cities and counties affected by the 12 Seismic Hazard Zone maps released in September 1998 (preliminary maps) and March 1999 (official maps).

COUNTIES	CITIES		
Los Angeles	Alhambra	Glendora	Palos Verdes Estates
	Arcadia	Hawthorne	Pasadena
	Azusa	Hermosa Beach	Rancho Palos Verdes
	Bell	Inglewood	Redondo Beach
	Bellflower	Irwindale	Rolling Hills
	Beverly Hills	La Verne	Rolling Hills Estates
	Bradbury	Lakewood	San Dimas
	Carson	Lawndale	San Marino
	Commerce	Lomita	Santa Monica
	Compton	Long Beach	Sierra Madre
	Culver City	Los Angeles	Signal Hill
	Duarte	Lynwood	South Pasadena
	El Segundo	Manhattan Beach	Torrance
	Gardena	Monrovia	Vernon
	Glendale	Montebello	West Hollywood
		Monterey Park	

Table 8. List of major handout sections and color key. Appendix 5 is a copy of the materials that were included in the handout booklet.

HANDOUT SECTION	PAPER COLOR
Cover and Introductory Pages	white
Seismic Hazards Mapping Act	blue
Seismic Hazards Mapping Regulations	green
Local government and real estate disclosure mandates, zoning criteria, map index, and map release schedule	white
Alquist-Priolo Earthquake Fault Zoning Act (for definition of project)	pink
Strong-Motion Instrumentation Program law (covers fee collection & fee retention)	goldenrod
Draft Users Guide	white, printed in color
Summary of responsibilities and functions under the Act	yellow
DMG contact information	green
Local contact Information	goldenrod
Map order information	pink
Guideline order information	buff

Near the close of the meeting, we distributed copies of the Seismic Hazards Mapping Bulletin and asked whether each participant wanted to be on our mailing list to received future issues. We also directed their attention to the fact that they could retain up to 5% of building permit fees that they collected for DMG's Strong-Motion Instrumentation and Seismic Hazard Mapping Programs, and what they could use those retained moneys for (seismic education and improving their agency's ability to conduct post-earthquake damage assessments). Finally, we asked them to decide to whom in their city we should send the maps and official correspondence.

Typical Questions and Comments

Throughout our whirlwind presentation, city and county officials asked questions. These questions and other comments made in the meetings revealed the broad range (nil to quite a bit) of expertise and political willingness that existed to implement the program. For example, some cities indicated that they would immediately begin requiring site investigations based on the map that we had just given them even though it had not yet been finalized or released for public review. Other cities indicated that their elected officials would likely postpone implementation until "one second after the deadline."

The following illustrates the questions and comments that we received, either at the meetings or shortly thereafter.

Q. Why were these maps selected for SHZ mapping?

A. The funding and data necessary to complete the six maps released in October were readily available. Most of the data was either in DMG files or was easily gathered from city and county records. The 39 southern California maps are within the area affected by the 1991 Northridge earthquake and are funded by the Federal Emergency Management Agency. The San Francisco map was developed as a prototype from 1993 through 1995.

Q. I already have the Alquist-Priolo Earthquake Fault Zone maps. How are the SHZ maps different?

A. The Alquist-Priolo maps show only the location of earthquake fault rupture hazards. The SHZ maps show additional potential hazards—liquefaction and landslides—which are caused by earthquake shaking and may occur tens of miles from the faults.

Q. How did DMG determine where to draw the lines on the hazard zone maps?

A. Geologists gathered and analyzed subsurface data to produce the maps. In general terms, the liquefaction hazard zone boundaries are based on the 40-foot historic high groundwater level in loose (uncompacted) sands and silts deposited during the last 10,000 years. The landslide hazard zone boundaries generally indicate steep hillslopes composed of weak materials that may fail when shaken by an earthquake.

Q. Where are the active faults in our city?

A. The SHZ maps do not show active faults. Those faults are shown on DMG's Alquist-Priolo Earthquake Fault Zone maps. Although your city may not have any active faults in it, there are one or more nearby faults that could generate strong enough earthquake shaking to cause liquefaction and/or landsliding. We also advised many cities about the atlas of "active fault near-source zones" which was released in 1998 (Division of Mines and Geology and Structural Engineers Association of California Seismology Committee, 1998).

Q. The law requires DMG to identify areas subject to strong ground shaking. Where are those zones on these maps?

A. DMG and U.S. Geological Survey jointly developed a statewide probabilistic earthquake shaking hazard map for California. That map has been incorporated into the liquefaction and landslide hazard zones. In essence, the SHZ maps indicate areas where ground conditions combined with anticipated levels of earthquake shaking are likely to produce liquefaction or landslide failures. Earthquake shaking hazards are addressed in the Uniform Building Code.

Q. The maps don't show new roads nor do they reflect recent grading. Does this mean the maps are based on outdated information and might not be valid?

A. DMG staff updated the topographic data using 1994 radar and aerial photographs. Although the updated data have not be incorporated into the base map, they were used in creating the landslide zones. On one map, the area in the landslide zones shrank by 30% after these new data were used. If the city or county knows of areas that were graded during or after 1994 and submits the information during the public comment period, we will revise the zones accordingly.

Q. How often will these maps be updated?

A. That has not been determined. When significantly large changes are warranted, we will update the maps assuming funding is available. One map (Anaheim) has already been updated.

Q. What will happen if the city refuses to adopt the maps?

A. The state and not the city is responsible for adopting the maps. Once the state issues the official maps, cities must, by law, require site investigations prior to issuing grading or building permits or approving land divisions that are subject to the Subdivision Map Act.

Q. What will happen should the city refuse to implement the SHMA?

A. That undoubtedly will be left to the court and others to decide. In the mid-1970's, the city of Fairfax failed to adopt state-required open-apace element as part of its general plan. The State Attorney General directed that, until Fairfax complied, all building

permits issued by the city were null and void. Future courts might find the city liable for not enforcing recognized state minimums for public safety. And failure to enforce might jeopardize, in whole or in part, future federal or state disaster relief when the inevitable future earthquake disaster occurs.

Q. How will the state know whether we are enforcing the law or not?

A. Cities and counties already are required to collect a building-permit fee and forward it to the Department of Conservation to fund the Strong-Motion Instrumentation and Seismic Hazard Mapping Programs. Thus, we know the dollar value of permit fees issued by individual cities and counties. If a substantial portion of a city of county is within a seismic hazard zone and we receive no site-investigation reports from that agency, we can check the building permit data and determine whether we need to investigate the matter further.

Q. Only part of our city is shown on the maps. This creates an inequity where we must require investigations of some permit applicants and not others. What do we do and when will the rest of our city be mapped?

A. We realize that partial coverage has created a dilemma for some cities and all four counties. However, the SHMA does not permit communities to delay imposing the site-investigation requirements until the entire city or county has been mapped. In some cases, zone maps covering the remainder of the city will be released within 2 to 18 months. In other cases, completion is dependent upon available funding and relative mapping priority of other parts of the state. Thus, it might be years before the rest of some cities will be mapped. Some parts of counties (e.g., in National Forests and military reservations) will likely never be mapped because of the low likelihood that they will be developed.

Q. What should be in a site investigation report?

A. DMG's Special Publication 117 contains much information to assist cities and counties. These guidelines generally describe the techniques that are commonly used to investigate liquefaction and landslide hazards—addressing which techniques yield good results and which yield inconsistent data. The guidelines also provide information on measures that have been used in the past to mitigate these hazards.

Q. How do the SP 117 guidelines compare with the Uniform Building Code (UBC; International Conference of Building Officials, 1997)? Do the two conflict?

A. That was a concern of the many people involved in developing the SP 117 guidelines. They are intended to mesh with the 1997 UBC.

Q. Alquist-Priolo prohibits construction over active faults? What types of mitigation measures have been used to deal with liquefaction and landslide hazards?

A. SP 117 contains lists of mitigation measures. In general, for landslide hazards, a engineering geologist will be required to investigate the site, identify existing landslide deposits and features and any planes of weakness (joints, bedding planes, etc.) which might fail if overloaded or undermined. A civil engineer will need to consider this information in designing cut and fill slopes, retaining walls, dewatering slopes, and the like. For liquefaction, mitigation measures might include lowering the water table, removing soil and replacing it with more densely packed material, adding steel or concrete to make foundations stronger, piles, stone columns, etc.

Q. In a number of cities, staff began discussing which of their agencies would be responsible for requiring the studies and issuing the permits. While some cities had a unified process, others required applicants to apply for a variety of permits from a number of city agencies.

A. When this occurred, we cautioned them that there were many ways to mitigate liquefaction hazards and that a unified investigation and mitigation approach would likely yield effective mitigation for lower cost. For example, overall layout of parking, structures, etc., often is a land-use planning issue, completed early in the process. Removal and replacement of soil material typically is a grading issue; and, foundation design is a structural issue. If a site investigation isn't required early in the process, developers may be forced to redesign the overall layout of the facility to reduce grading or foundation costs. A divided approach risks each agency imposing duplicative mitigation requirements, recycled permit change applications, or both, which can be costly to the developer and frustrating for both developers and city staff.

Q. Is the city or county responsible for the technical expertise to review geotechnical reports for their adequacy and to determine mitigation?

A. Yes. A city or county may use either a certified engineering geologist, registered civil engineer, or both with competence in the field of seismic hazard evaluation and mitigation to review site-investigation reports for adequacy. The reviewer may be either on staff or a retained consultant.

Q. The SHMA and the associated regulations state that the lead agency is required to review the geotechnical reports and recommended mitigation measures to determine their adequacy. Who bears the cost of the reviews?

A. Local governments are responsible for reviewing the geotechnical reports to ensure their adequacy as defined by California Code of Regulations, Section 3724(c). Most local governments pass these costs on to the applicant as part of permit fees.

Q. "Acceptable levels for protection of public safety" is a term that may not be consistent throughout the state. Would that phrase be left to interpretation on a project-by-project basis?

A. The state's definition of "acceptable level" is the minimum level at which ground failure is not expected to cause loss of life. Cities and counties may be more restrictive. It is up to each jurisdiction to define the term and consistently apply it in its approval process.

Q. How do these new maps affect projects that have not yet been constructed due to economic conditions but for which permits have already been issued?

A. If all permits have been issued, the city may be unable to require design changes without having to bear the cost. In that instance, the only recourse may be to advise the developer of the new law and disclosure requirements and encourage investigation and design changes. (See *See the Sea*, Limited, supra, 9 Cal.3d 888—re: in passing California's Coastal Zone Conservation Act, Legislature did not intend to impose building moratorium on owners who had obtained a building permit for completion of construction that has already commenced.) However, if some of the required permits (e.g., grading or building) have not been issued, the city or county must require the site investigation because mitigation is still possible to require. (See *Avco Community Developers Inc. v. South Coast Regional Commission*, California Supreme Court, Aug. 25, 1976—although subdivision had been approved, rights are not vested until building permit is issued and a builder must comply with the laws that are in effect at the time a building permit is issued.)

Q. The city or county must send a copy of the site-investigation report to the state within 30 days after its acceptance. Why do these documents need to be filed with the state? Is state approval of a report required before issuance of permits?

A. The state has no authority to approve or reject the report. The reports are collected by DMG for the data they contain. The information becomes part of DMG's database to improve and update the maps in the future.

Q. Does the state collect any payments with the submittal of the site-investigation reports?

A. There are no new fees. The Department of Conservation already receives a portion of building-permit fees collected by local governments.

Q. Do all mitigation measures need to be implemented and inspected by building or grading officials?

A. The city is responsible for verifying any mitigating measures it requires.

Q. When a property located in a "zone of required investigation" is sold, is the owner required to disclose this fact to potential buyers?

A. Yes. The disclosure requirement applies regardless of the findings of the site-investigation or mitigation measures that have been taken.

Q. Mapping of only a portion of a city can present the city with a dilemma in areas that have yet to be mapped. At least one city official indicated that the city probably would await completion of all of its jurisdiction before enforcing the requirements of the SHMA.

A. While we realize that we may have created a situation where development requirements are not uniform within an individual city, the SHMA does not permit an exemption with that as its basis. City staff should consult with the city attorney and local policy makers regarding the potential consequences.

Q. Once a property has been investigated and no hazard found, will the zone be removed?

A. When sufficiently large areas are investigated and no hazard is found, the maps will be updated, funding permitting. Until the zones are removed, disclosure is required when the property is sold. Sellers should disclose that the property is within a Seismic Hazard Zone and should refer buyers to the site-investigation reports for more information.

Q. Once a property has been investigated and the hazard has been mitigated, will the zone be removed?

A. Some mitigation measures (e.g., removal and replacement of liquefiable material) effectively rid part or all of a property of the hazard while others (e.g., strengthening a building's foundation) only treat the current structure. In the latter case, when the structure is replaced, additional mitigation may be required for the new structure. When sufficiently large areas are permanently remedied, the maps will be updated, funding permitting. However, as indicated in the previous answer, until the zones are removed, disclosure is required when the property is sold. Sellers should disclose that the property is within a Seismic Hazard Zone and should refer buyers to the site-investigation reports for more information.

Q. When will SHZ maps be available for the rest of the state?

A. It is not cost-effective to map areas of the state that are unlikely to be developed. How soon the remaining high-risk areas in greatest need of seismic zoning will be completed largely depends on funding.

Q. The SHZ map is too small. Can I get a larger map which shows property lines?

A. The maps are available only at a scale of 1:24,000 (1"=2,000 ft.) which is suitable for use as a planning tool for local governments; the maps are not intended to provide site-specific information. The cities and counties, not the state, maintain property description information. It is up to each city and county to interpret the maps and determine whether site investigations are required. DMG will make the maps available in digital form. Cities and counties can import these data into their geographic information systems (GIS) and produce lists of affected properties or maps that identify affected parcels. These lists or maps in effect become the city's or county's interpretation of the state's zone maps. Each city may make the information available as it

sees fit. For example, San Francisco has given the list to a local real estate association and has posted it at DMG's web site. Such action helps assure consistent interpretation of the maps but may not absolve property owners or real estate agents from liability in case of error.

Q. I was told that I have to order the SHZ maps and guidelines from a reproduction company. Since they are produced with public money, why aren't they free?

A. DMG would have to charge for printing, storing, and mailing the maps. In keeping with the Governor's policy of reducing the size of state government, one reproduction firm has agreed to store and print black and white copies of the maps on demand at no cost to the state. That company charges for reproduction, shipping and handling, but its per-unit cost is lower than the state currently can provide. DMG also gives reproducible copies of the black and white maps to affected cities and counties, encouraging them to make copies available for over-the-counter sale or from a local reproduction firm. As of October 1999, color versions of some of the maps were available from DMG's web site in a format that can be viewed on most computers and that many vendors can obtain and plot.

Q. Will insurance rates rise or property values decline within the SHZs?

A. We have yet to see evidence of a significant decline in property values in these zones. Palm (1981) and Palm and others (1983) determined that the Alquist-Priolo Earthquake Fault Zone maps had virtually no effect on property values. However, anecdotal evidence suggests that property values may have declined along the Hayward Fault during the six months following the Loma Prieta earthquake—a short-term impact. Future earthquakes near zoned areas may result in similar short-term declines. Many factors are used to determine insurance rates. Most insurance companies already recognize existence of these hazards and have set rates accordingly. If owners have already taken appropriate mitigation measures, they should let their insurance company know—they may be eligible for a discount.

Q. Real estate agents are asking cities and counties whether affected properties are in or outside of SHZs. What should cities and counties do?

A. For sale of real property, the SHMA and Natural Hazards Disclosure Statement places the burden of determining whether properties are affected on the seller and/or the seller's agent. Counties are required to post notices in specified locations identifying any available SHZ and Alquist-Priolo maps. It's the responsibility of sellers and agents to check those lists to determine whether hazard zone maps of their community exist. Technically, cities and counties aren't obligated to determine whether a property is within a SHZ until approval of a development project is requested. However, at least one city (San Francisco) has produced a list of affected properties for use at their public counter and made the list available on floppy disk and the Internet.

DMG routinely sends three paper copies of each preliminary map and one reproducible of each official map that affects a jurisdiction. Several jurisdictions (e.g., the three counties and the city of Los Angeles) almost always requested large numbers of additional copies. Thus, DMG began sending reproducible copies of the preliminary maps instead of the paper copies to those agencies.

Finally, some cities and counties openly expressed a reluctance to enforce the requirements of the Seismic Hazard Mapping Act. Several of these cities questioned the reasonableness of liquefaction zones that are based on historic instead of present-day ground water levels. We think it is likely that DMG will receive significant pressure to revise the zoning criteria in the future unless a significant number of investigations reveal zones of perched water that are unknown to local officials.

In direct contrast, on receiving the maps and being briefed by DMG staff, several cities indicated

that they would immediately require investigations for new development projects, without waiting for release of the preliminary or official zone maps.

Also, SHMA currently exempts one- and two-story single-family frame dwellings from site-investigation requirements unless they are part of a development of four or more units. This exemption has prompted some cities that previously required site investigations for individual dwellings to amend their requirements to parallel the SHMA. Thus, in some jurisdictions, fewer sites are being investigated following release of the zone maps.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

General Conclusions

Earlier in this document, we asserted that the success of the Seismic Hazards Mapping Act (SHMA) depends not only on the technical capabilities of DMG staff, SMGB, and their advisory committees, but also on (1) local building officials, planners, engineering geologists, civil engineers who work for local agencies, (2) consulting engineers and engineering geologists who perform site investigations, and (3) real estate professionals and property owners. After distributing copies of the SHZ maps and information about the SHMA to more than 100 cities and counties, consulting engineers and geologists, real estate professionals, and the public, we have reconfirmed the following:

1. State-legislated mandates that hazard maps be used in land-use planning and development processes increase the likelihood that hazards will be identified and mitigated. Many cities and counties tend to ignore geologic or hazard maps that lack such a mandate.
2. Technical reports that summarize the scientific basis and rationale for zoning are extremely useful to consulting geologists and local agency reviewers.
3. Peer review requirements equip local agencies with in-house experts or readily accessible consultants that understand local issues, and assure that site investigations and resulting recommendations are reasonable.

Meetings with individual cities and counties are an effective means of educating their staffs about the zone maps and the requirements of SHMA. These meetings help assure that hazard maps and information reach the "right" local staff—those who will implement the requirements at the local level. Even though the maps portray information that some cities would prefer to ignore, all those visited appreciated the individualized meetings that enabled them to ask questions and express concerns.

Insights gained by DMG staff from those meetings and the in-depth interviews of four cities and counties have contributed to making the program more effective. Distribution of information was improved, local implementation issues were quickly identified, and questions and concerns of other users were made known.

Principal Recommendations

Mapping of only a portion of a city can present the city with a dilemma. Whenever feasible, DMG should attempt to map cities in their entirety to minimize such dilemmas.

DMG should routinely send reproducible copies (instead of paper copies) of the preliminary SHZ maps to affected cities and counties.

Outdated base maps and printed patterns make the maps difficult to use. In areas where the maps fail to depict that the terrain has been extensively modified, users may need a GIS or similar tool to expertly transfer zone boundaries to more-current base maps. To facilitate use, DMG should acquire up-to-date base map information for publication in the official zone maps. Because it is likely that the terrain will be altered in the future, perhaps long after the maps have been released, current zone maps should be reissued on new base maps, whether or not the zones are revised, as they become available from the U.S. Geological Survey or other appropriate sources.

Color prints of all preliminary and official seismic hazard zone maps should be made available for public purchase as quickly as possible. DMG should also explore the potential for commercial production and distribution of paper and digital versions of the maps in an up-to-date street atlas format.

Technical reports summarizing the data and methods used to produce the zone maps should be made available when the preliminary maps are

released for review and comment. This will enable cities, counties, and consultants to better understand the basis for the zoning, remove uncertainties, and better comment on the maps.

Most cities and counties use one of two administrative tools—ordinances and/or permit-review procedural checklists—to assure that hazards are identified and mitigated. In a very few cases, it appears that city or county staff are required by local administrators to use maps and policies contained in the city of county safety element instead of the state maps. In those jurisdictions, effectiveness of the program might be hindered until after their safety element is revised and altered to incorporate new and existing SHZ maps by reference. Such problems could be avoided by including a policy similar to the one contained in Simi Valley's safety element as quoted on page 16. Ideally each local safety element should also consider issues related to "acceptable risk." Such an analysis should include a discussion of potential losses, costs and feasibility of mitigation, survivability, and post-disaster economic recovery. Armed with this knowledge, local decision makers can formally adopt a finding regarding the level of risk that the city or county deems acceptable. That finding can, in turn, be used by local building officials and planning departments, in the permit review and approval process. California's General Plan Guidelines (published by the Governor's Office of Planning and Research) should consider these issues and recommend ways that local agencies can address or minimize future implementation problems. The State Mining and Geology Board, possibly in concert with the Office of Planning and Research, should address these issues in future regulations and/or implementation guidelines.

DMG staff should revisit Anaheim, Simi Valley, Orange County, and Ventura County for the purpose of documenting the changes that have occurred and issues that have been raised since the official zone maps have become available. Staff should also expand the study to include at least two additional cities, smaller in size, to document how they are implementing this program.

The User's Guide, currently available on the Internet, should be completed, printed, and distributed to affected local agencies. The guide should be a largely nontechnical document in a format that can be used by local governments to educate their staff and the public. It should include descriptions and photographs, discussion of the hazards mapped, information about mitigation techniques and costs, short case histories describing how cities and counties have implemented various aspects of the program, and suggestions to facilitate cost-effective mitigation.

Although electronic distribution of information (e.g., via the Internet) is increasingly effective, printed media will be required to reach some local officials that lack Internet access. Periodic newsletters, informational pamphlets, technical guidelines and reports, meetings, workshops, training courses, and public displays all were effective tools for disseminating needed information to many diverse audiences. DOC's web site has been effective in increasing access to much of this same information and has minimized the number of local and state agency staff required to answer questions following releases of new maps and information. This multiple media approach to distributing maps and information should continue.

DMG's proactive outreach—particularly the holding of individualized meetings with local agencies—warrants continued effort, as do short courses, workshops, and briefings of various professional groups. However, future program effectiveness requires a sustained effort to educate city and county staff and local elected officials about the SHMA. Tools such as videos and interactive CD-ROM's should be developed to assist in training of these staff and officials. Also, because a significant number of residents speak Spanish, DMG should consider translation of some written materials into Spanish. Whenever possible, Spanish-speaking staff should be available at media events to provide television and radio interviews.

The potential exists for some cities and counties to ignore some or all of the requirements of the Seismic Hazards Mapping Act. As site-investigation reports are received, submitted reports should be acknowledged and the information catalogued to expedite recovery. These data might become key to documenting local pre-disaster compliance.

DOC should work with OES, FEMA, Seismic Safety Commission, State Attorney General, insurers, lenders, and other interested parties to encourage local compliance.

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Appendix 1–Sample issue of the Seismic Hazard Mapping Bulletin

APPENDIX 1

Sample Issue of the Seismic Hazard Mapping Bulletin

Seismic Hazard Mapping Bulletin #4

California Department of Conservation
Division of Mines and Geology
801 K Street, MS 12-31
Sacramento, CA 95814

Department of Conservation Releases New Preliminary Seismic Hazard Zone Maps

On August 1, 1997, the California Department of Conservation released five new preliminary seismic hazard zone maps covering parts of Los Angeles and Ventura counties. Five additional maps and two revisions are planned for release in October (see chart below and map on page 2).

Cities covered by the August 1 release include all or portions of Calabasas, Agoura Hills, Hidden Hills, Los Angeles and Santa Clarita. Each of the five maps covers approximately 60 square miles at a scale of one inch equals 2,000 feet.

The maps are being distributed to local officials for technical review as part of the state's seismic hazard mapping program mandated by the Seismic Hazard Mapping Act of 1990. The first set of maps, which included 19 communities in portions of Los Angeles, Orange and Ventura counties, were released in final form in April 1997.

The maps show areas which, during an earthquake, have an increased susceptibility to landslides or to water-saturated ground failure known as liquefaction. Much of the mapped area is underlain by saturated sands and silts that may liquefy during intense ground shaking, or are steep slopes composed of weak materials, where earthquakes are likely to trigger slope failure.

Following a six-month technical review period, the maps will be released as official seismic hazard zone maps by February 1, 1998. The official maps will then be used by local officials to identify areas for required site-specific investigation before permitting new urban development.

The State Mining and Geology Board adopted ***Guidelines for Evaluating and Mitigating Seismic***

(Continued on page 2)

Cities/Counties Affected by Released Seismic Hazard Zone Maps

April 1997 Official Maps	August 1997 Preliminary Maps	October 1997 Preliminary Maps
Anaheim	*Agoura Hills*	*Anaheim*
Buena Park	*Calabasas*	*Brea*
Costa Mesa	*Hidden Hills*	*Buena Park*
Cypress	*Los Angeles*	*Costa Mesa*
Fountain Valley	*Santa Clarita*	*Fullerton*
Fullerton	*Los Angeles County*	*Industry*
Garden Grove	*Ventura County*	*Irvine*
Huntington Beach		*Laguna Beach*
Los Angeles		*La Habra*
Malibu		*La Habra Heights*
Moorpark		*La Mirada*
Newport Beach		*Los Angeles*
Orange		*Newport Beach*
Placentia		*Orange*
San Francisco		*Placentia*
Santa Ana		*Santa Ana*
Santa Monica		*Tustin*
Simi Valley		*Whittier*
Stanton		*Yorba Linda*
Westminster		*Orange County*
Orange County		*Los Angeles County*
Los Angeles County		
Ventura County		

(Continued from page 1)

Hazards in California (Special Publication 117) for local governments to use in evaluating seismic hazards and to propose siting and construction techniques within the identified hazard zones.

Subsequent preliminary maps for the three-county area affected by the Northridge earthquake will be distributed for review approximately every six months until the currently funded total of 38 maps are produced (see map).

Local governments and other interested parties now have until November 1, 1997 to review and comment on the maps. Comments from interested parties or organizations must be submitted to the State Mining and Geology Board by that date. The Board's address is:

801 K Street, Room 24-05
Sacramento, CA 95814

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Open-File Reports Available on Web

Preprints of background documentation for official hazard zone maps are available for the first six maps released on April 1, 1997—Anaheim, Newport Beach, Topanga, Simi East, Simi West and San Francisco. They can be found on the Department of Conservation Web site: http://www.consrv.ca.gov/. Printed reports will be available later this year.

The reports document the methods and data used to produce liquefaction and earthquake-induced landslide zone maps. Information such as location of borings, landslide features, and historic groundwater levels are included. Although not available in the preprints, the final reports will include the ground motion data used in the computer model that generated the hazard zone maps.

While the base maps on which the zone maps are printed date from the 1960s, the topographic information used in the analyses locally is from recent aerial photos and radar data. Any new topographic information obtained in the review, such as large-scale grading, will be identified in the reports.

Preprints of the reports for preliminary seismic hazard zone maps released on August 1, 1997—Calabasas, Canoga Park, Oat Mountain, Newhall, and Van Nuys quadrangles—should be on the Web site by mid-August. A copy of the preprint will be provided to each affected city and county to use in reviewing maps. Other users should obtain copies from the Web.

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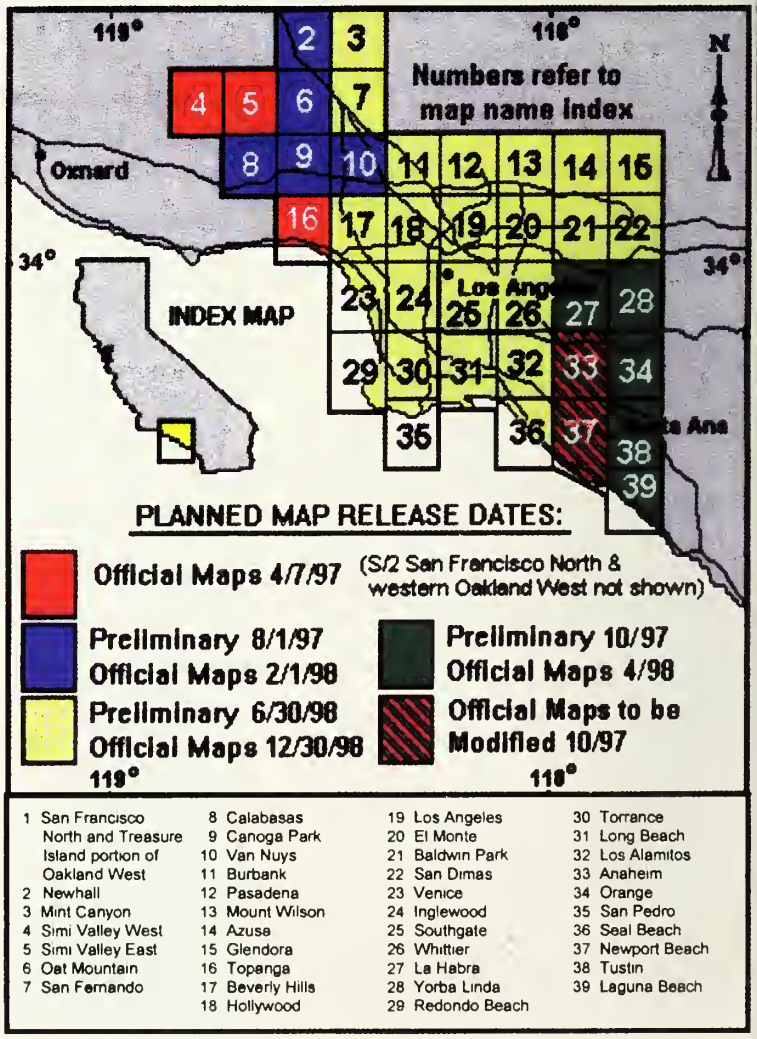
Digital Seismic Hazard Maps Available

The zone data layers on the six official seismic hazard zone maps which were made official in April 1997 are now available in digital form from the Department of Conservation. These maps include the San Francisco North, Anaheim, Newport Beach, Simi East, Simi West, and Topanga quadrangles.

The available data formats include DXF and Intergraph Design File (DGN). Many GIS programs can import DXF data. These files may be obtained via the Internet from ftp://ftp.consrv.ca.gov/pub/dmg/shezp/zonemaps/. They are also available by linking to the Department of Conservation Web site (http://www.consrv.ca.gov/).

Cities and counties that do not have Internet access may obtain the files on a floppy disk. Contact Ted Smith at (916) 323-8569.



Southland Panel to Consider Seismic Review Standards

Concern about selecting appropriate analysis guidelines and mitigation measures to implement the Seismic Hazard Mapping Act has led Southern California agencies to seek jointly proposed review standards for liquefaction and slope stability.

The committee, still in its formative stages, will be co-chaired by Dr. Geoffrey Martin, professor of civil engineering at the University of Southern California, and Dr. Marshall Lew, vice-president of Law/Crandall, a geotechnical consulting firm in Los Angeles.

According to Dr. Martin, representatives from the City of Los Angeles and the counties of Orange, Ventura, Los Angeles, Riverside, San Bernardino and San Diego have agreed to participate.

The state's regulatory requirement to investigate liquefaction and slope stability prior to construction of a structure for human occupancy raises the question of acceptable level of risk for permitting agencies. The committee will recommend levels of acceptable risk (expressed, for example, in terms of acceptable levels of ground deformation) and recommend appropriate methods of mitigation based on current engineering practices.

Dr. Martin says the committee will begin meeting monthly as soon as all committee members and contacts are confirmed. He expects the committee to produce a mutually acceptable document by the end of 1997.

Charles Real, manager of the Department of Conservation's seismic hazard mapping program, will participate as an advisor.

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Just the FAQs

Frequently asked questions about earthquake hazards, the Seismic Hazard Mapping Act and the Seismic Hazard Zone Maps.

Q. Is the city or county responsible for the technical expertise to review geotechnical reports for their adequacy and to determine mitigation?

A. Yes. A city or county may use either a certified engineering geologist, registered civil engineer, or both with competence in the field of seismic hazard evaluation and mitigation to review site-investigation reports for adequacy. The reviewer may be either on staff or a retained consultant.

Q. Page 7(c) of the Guidelines states that the lead agency is required to review the geotechnical reports to determine the adequacy of geotechnical reports and mitigation measures. Who bears the cost of the reviews?

A. Local governments are responsible for reviewing the geotechnical reports to ensure their adequacy as defined by California Code of Regulations, Section 3724(c). Most local governments pass these costs on to the applicant as part of permit fees.

Q. Acceptable levels for protection of public safety is a term that may not be consistent throughout the state. Would each project be left to interpretation?

A: The state's definition of "acceptable level" is the minimum level at which ground failure is not expected to cause loss of life. Cities and counties may be more restrictive. It is up to each jurisdiction to define the term and apply it in its approval process.

Q. The city or county must send a copy of the site-investigation report to the state within 30 days after its acceptance. Why do these documents need to be filed with the state? Is state approval of a report required before issuance of permits?

A. The state has no authority to approve or reject the report. The reports are collected by DMG for the data they contain. The information becomes part of DMG's database to improve and update the maps in the future.

Q. Does the state collect any payments with the submittal of the site-investigation reports?

A. There are no new fees. The Department of Conservation already receives a portion of permit fees collected by local governments.

Q. Do all mitigation measures need to be completed by finals of construction on new projects?

A. The city is responsible for verifying any mitigating measures it requires.

Q. When a property located in a "zone of required investigation," is sold, is the owner required to disclose this fact to potential buyers?

A. Yes. The disclosure requirement applies regardless of the findings of the site-investigation or mitigation measures that have been taken.

Q. Should the requirements of the Seismic Hazard Mapping Act be adopted into the city's municipal code?

A. The Act leaves the mechanism for implementing its requirements to the discretion of local governments. Some cities will choose to adopt an ordinance; others will make the requirements part of their permit review process without an ordinance. The only other requirement in the Act is that local governments consider the map information when revising their general plans.

To Order Seismic Hazard Zone Maps

Official and preliminary seismic hazard zone maps are available for a fee from:

BPS Reprographic Services
149 Second Street
San Francisco, CA 94103
(415) 512-6550

Maps must be ordered by quadrangle name (see map page 2). Contact BPS for price information.

To Order Guidelines

As mandated by the Seismic Hazard Mapping Act of 1990, the Department of Conservation has produced statewide guidelines, *Guidelines for Evaluating and Mitigating Seismic Hazards in California*, Special Publication 117. Copies of the guidelines are available for $15 per copy, including tax and postage. Checks, money orders, VISA and MasterCard are accepted.

To order by mail, write the Department of Conservation, PO Box 2980, Sacramento, CA 95812-2980.

To review and/or purchase, visit Department of Conservation Division of Mines and Geology offices at:

107 S. Broadway, Room 1065 **Los Angeles, CA 90012-4402**	**(213) 620-3560**
185 Berry Street, Room 210 **San Francisco, CA 94107-1728**	**(415) 904-7707**
801 K Street, Room 1400 **Sacramento, CA 95814-3532**	**(916) 445-5716**

For more Information . . .

The **Department of Conservation's Division of Mines and Geology** posts information pertaining to the Seismic Hazard Mapping Program at the Department of Conservation's Web site: **http://www.consrv.ca.gov/.** For information about outreach services available to local governments, contact:

Bea McKamey, Outreach Specialist
Voice: (916) 324-1407
Fax: (916) 445-3334
E-mail: bmckamey@consrv.ca.gov

For assistance with guideline and/or map interpretation, questions or comments about the home page, or availability of data and data services, contact:

Ted Smith, Outreach Coordinator
Voice: (916) 323-8569
Fax: (916) 445-3334
E-mail: tsmith@consrv.ca.gov

Seismic Trivia

Hundreds of earthquakes occur each day in California. Most are less than magnitude 3—too small to be felt by humans. They are detected and recorded by a seismograph network operated by state and federal agencies. California is the second most seismically active state, following Alaska. Other states with large numbers of earthquakes are Hawaii, Nevada, Utah, and Idaho.

Department of Conservation
Division of Mines and Geology
Seismic Hazard Mapping Program
801 K Street, MS 12-31
Sacramento, CA 95814

Appendix 2–Informational Brochure:
Seismic Hazard Zone Maps

APPENDIX 2

Informational Brochure:
Seismic Hazard Zone Maps

California Is [redacted] Country

Most people in California live within 30 miles of an earthquake fault. More than 200 faults in California could produce a damaging earthquake.

Earthquake damage most often occurs in locations that we know about. The areas most likely to suffer damage include soils that are susceptible to liquefaction, steep slopes prone to landslides, and areas near faults. When these sites are identified, they can be avoided or structures can be designed to resist collapse and damage. Such measures could save tens of thousands of dollars per home when the next earthquake occurs.

Liquefaction

If a layer of sandy soil near the ground surface is saturated with water and shaken by an earthquake, the soil can flow like a liquid. If the ground fails above the liquefied zone, it can cause severe damage to structures, roads, and utilities. Seismic hazard zone maps published by the Department of Conservation show areas where site investigations are required because of the potential for liquefaction.

Liquefaction damage at King Harbor, Redondo Beach, caused by the January 17, 1994 Northridge earthquake. *Photo by Siang Tan, Division of Mines and Geology*

Landslides

Steep, unstable hill slopes may slide when an earthquake occurs and boulders may roll down slope. The seismic hazard zone maps published by the Department of Conservation show areas where site investigations are required because of the potential for landsliding.

A landslide triggered by the January 15, 1994 Northridge earthquake destroyed a home on the Pacific Coast Highway near Santa Monica. *Photo by Siang Tan, Division of Mines and Geology*

Faults

Faults can cause the ground to break as they move during an earthquake. The Department of Conservation's Alquist-Priolo earthquake fault zone maps show surface traces of known active faults. Today it is illegal to build new structures for human occupancy over the surface trace of an active fault.

Department scientists also collect information about faults that do not break the surface but that can cause earthquakes. Although those faults are not shown on Alquist-Priolo maps, engineers use the information to design schools, hospitals and other important structures.

Learn more about earthquakes

California Geology. A bimonthly publication of the California Department of Conservation, 801 K St., Sacramento, CA 95814-2980 ($12.00 per year).

Earthquakes. By Bruce Bolt, 1993. W.H. Freeman. 41 Madison Ave. New York, N.Y. 317 pages ($22.95).

Earthquakes: A Teacher's Package for Grades K-6. National Science Teachers Association, 1988. 288 pages ($17.95 plus $4.25 PH). (800) 722-6782.

Preparing for an earthquake

Peace of Mind in Earthquake Country. By Peter I. Yanev. 1991. Chronicle Publishers, San Francisco. 218 pages. ($14.50 plus postage and CA sales tax). (800) 722-6657.

Surviving the Big One, How to Prepare for a Major Earthquake. KCET Video, 1989. ($19.95 plus $6.00 postage/handling and CA sales tax). (800) 343-4727.

Emergency Survival Handbook. American Red Cross. ($3.00 plus $2.00 postage/handling). (213) 739-5289.

Putting Down Roots in Earthquake Country. Southern California Earthquake Center, 1995. 32 pages. (213) 740-1560. (Minimum of 10 copies per order, $1.00 each plus shipping/handling).

Get more information

California Department of Conservation, Division of Mines and Geology, 801 K Street, Room 1400, Sacramento, CA 95814. (916) 445-5716. Home page: http://www.consrv.ca.gov/. Maps of faults and geologic hazards, a statewide earthquake shaking map, and scenarios describing the likely effects of future earthquakes in California.

U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025. (415) 853-8300. Home page: http//www.usgs.gov/. Books, maps, photographs and videos about geology, water, ecology and soils in the western US with a special collection of educational materials for K-12 teachers.

Alameda*, Los Angeles, Orange, San Francisco, Santa Clara*, and Ventura Counties. Contact your local city and county planning and building departments for more information and updates about local requirements.

***Note:** Preliminary maps affecting parts of these counties will be released in mid-1999.

99-23972

Seismic Hazard Zone Maps

STATE OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY

Gray Davis, Governor
Mary D. Nichols, Resources Secretary
Steve Arthur, Acting Director

Seismic Hazard Zone Maps

The Seismic Hazard Mapping Act requires the Department of Conservation to identify and map the state's most prominent earthquake hazards. The Act was passed in 1990 following the Loma Prieta earthquake to reduce threats to public health and safety and to minimize property damage caused by earthquake hazards.

As of March 25, 1999, 40 official seismic hazard zone maps showing areas prone to liquefaction and landslides have been issued. More maps are scheduled to be released in mid-1999. State scientists will eventually delineate these zones in each of California's major urban areas.

What do the maps show?

The maps show areas where investigations are required for liquefaction and landslide hazards before development and construction permits can be obtained. For new structures, the investigations must demonstrate that the site is suitable or can be made suitable for most proposed buildings. Owners must advise prospective buyers that property (whether developed or not) is within a seismic hazard zone when the property is sold.

What areas are covered by the maps?

One of the seismic hazard zone maps covers the northern half of San Francisco. The other 39 maps cover the area most affected by the 1994 Northridge earthquake in Ventura, Orange, and Los Angeles counties.

Who is affected by the maps?

Cities and counties must use the official maps to regulate development within identified seismic hazard areas. The intent is to assess earthquake hazards so structures can be designed and located to reduce damage from future earthquakes. Within these zones, city and county agencies must withhold development permits until geologic or soils investigations are conducted and site-specific safety improvements are incorporated into development plans.

Do the maps affect owners of existing homes?

If a property is within a seismic hazard zone, homeowners or their agents must disclose that fact when the property is sold.

How are these maps different from the ones already being used?

You may be thinking of the Alquist-Priolo earthquake fault zone maps which show only the location of earthquake fault rupture hazards. These seismic hazard zone maps show areas where there may be additional hazards—liquefaction and landslides. These hazards can be triggered by earthquake shaking and may cause damage many miles from the faults.

Some local governments or other parties have prepared liquefaction and landslide hazard maps for selected areas. The seismic hazard zone maps prepared by the Department of Conservation are different from the localized maps in three key ways:

- → Scientists use the latest geotechnical data and state-of-the-art computer technology to produce the maps.
- → A standardized method that has undergone rigorous scrutiny by scientists and public policy experts is used to evaluate hazard potential throughout the state.
- → Maps are prepared at a scale large enough to be used by cities and counties.

How are the maps prepared?

The seismic hazard zone maps result from detailed analyses by California Department of Conservation geologists and seismologists. These scientists gather information about surface and subsurface geology, historic groundwater levels and damage and geologic effects of earthquakes throughout California. They use the data to make a three-dimensional view of the local terrain and to analyze the effects of earthquake shaking with state-of-the-art geographic information system technology.

Who is paying for the mapping project?

The Seismic Hazards Zone Mapping Program is funded by building permit fees. Mapping of Los Angeles, Orange and Ventura counties is partially funded by a Stafford Act mitigation grant from the Federal Emergency Management Agency and the Governor's Office of Emergency Services.

How can I find out whether my property is in a hazard zone?

Planning and building departments of cities and counties affected by the zones have copies of the official seismic hazard zone maps and as well as Alquist-Priolo earthquake fault zone maps. The seismic hazard zone maps also are available at the Department of Conservation's Web site: http://www.consrv.ca.gov/. Black and white copies of the maps may be purchased from:

BPS Reprographic Services
149 Second Street
San Francisco, CA 94105
Telephone: (415) 512-6550

How can I tell whether the map that I have is a Seismic Hazard Zone Map?

The following text appears on all Seismic Hazard Zone Maps for which real estate disclosure is required by California Public Resources Code Section 2694:

STATE OF CALIFORNIA
SEISMIC HAZARD ZONES

Delineated in compliance with Chapter 7.8, Division 2 of the California Public Resources Code (Seismic Hazards Mapping Act)

[NAME OF] QUADRANGLE
OFFICIAL MAP/REVISED OFFICIAL MAP

Effective: [Date]

[Signature of State Geologist releasing map]
STATE GEOLOGIST

Cities and Counties Affected By Seismic Hazard Zones

Note: This information is current as of March 25, 1999. For updates, see http://www.consrv.ca.gov/dmg/shezp/affected.htm

COUNTIES

Los Angeles
Orange
San Francisco
Ventura

CITIES

Agouro Hills
Anoheim
Arcodia
Artesia
Azusa
Baldwin Park
Bell
Bell Gardens
Bellflower
Beverly Hills
Brea
Buena Park
Burbonk
Calabasas
Carson
Cerritos
Commerce
Compton
Costa Mesa
Covina
Cudahy
Culver City
Cypress
Diamond Bar
Downey
Duarte
El Monte
El Segundo
Fountain Valley
Fullerton
Garden Grave
Gardena
Glendale
Glendoro
Howaiian Gordens
Hermoso Beach
Hidden Hills
Huntington Beach
Huntington Pork
Industry
Inglewaod
Irvine
Irwindale
La Canoda-Flintridge
La Hobra
La Habro Heights
La Miroda
La Polma
La Puente
La Verne
Laguna Beach
Lakewoad
Lamita
Lang Beach
Los Alamitos
Los Angeles
Lynwoad
Molibu
Monhottan Beach
Maywood
Monrovia
Montebello
Monterey Park
Moarpark
Newport Beach
Norwalk
Orange
Polas Verdes Estates
Paramount
Pasadena
Pica Rivera
Placentia
Pomona
Rancho Palos Verdes
Redondo Beoch
Rolling Hills
Rolling Hills Estotes
Rosemead
San Dimas
San Fernonda
San Francisca
San Gabriel
San Marino
Santo Ana
Santo Clarita
Santa Fe Springs
Sonta Monico
Seal Beach
Sierra Modre
Signal Hill
Simi Valley
Sauth El Monte
Sauth Gote
Sauth Pasodeno
Stanton
Temple City
Torrance
Tustin
Vernon
Villa Park
Walnut
West Covina
West Hollywoad
Westminster
Whittier
Yorba Linda

NOTE: Althaugh located within the mapped area, the cities af Alhambra, Bradbury, Hawtharne, and Lawndale currently are not affected by any seismic hazard zanes

Appendix 3–List of Technical Abstracts, Papers and Publications

APPENDIX 3

List of Technical Abstracts, Papers and Publications Produced in Support of the Seismic Hazard Mapping Program

Anonymous, 1997, DMG releases official seismic hazard zone maps and guidelines for evaluating and mitigating seismic hazards: California Geology, v. 51, n. 2, p. 23.

Anonymous, 1997, Release of new preliminary seismic hazard zone maps: California Geology, v. 50, n. 6, p. 193.

Anonymous, 1998, Release of new official seismic hazard zone maps: California Geology, v. 51, n. 2, p. 23.

Anonymous, 1998, Release of new official seismic hazard zone maps: California Geology, v. 51, n. 4, p. 27.

Cao T., M.D. Petersen and M.S. Reichle, 1996, Seismic hazard estimate from background seismicity in Southern California: Bulletin of the Seismological Society of America, v. 86, p. 1372-1381.

Cramer, C.H. and M.D. Petersen, 1996, Predominant Seismic Source Distance and Magnitude Maps for Los Angeles, Orange, and Ventura counties, California: Bulletin of the Seismological Society of America, v. 86, p. 1645-1649.

Cramer, C. H. M.D. Petersen, and M.S. Reichle, 1996, A Monte Carlo approach in estimating uncertainty for a seismic hazard assessment of Los Angeles, Ventura, and Orange Counties, California: Bulletin of the Seismological Society of America, v. 86, p. 1681-1691.

DeLisle, M.J., C.L. Pridmore, R.C. Loyd and M.E. Mattison, 1998, Liquefaction zone maps of portions of Los Angeles, Orange, and Ventura counties, California: Geological Society of America, Abstracts With Programs, Cordilleran Section, v. 30, n. 5, p. 11.

Greenwood, Richard B., 1998, Map of historically highest perched and near-surface water in Holocene-age sediments, Orange County coastal plain, southern California: Geological Society of America, Abstracts With Programs, Cordilleran Section, v. 30, n. 5, p. 16-17.

Greenwood, Richard B., 1998, Stratigraphic section of Holocene-age sediments, Orange County coastal plain, southern California: Geological Society of America, Abstracts With Programs, Cordilleran Section, v. 30, n. 5, p. 16.

Hitchcock, C.S., R.C. Loyd and W.D. Haydon, 1996, Liquefaction susceptibility and hazard zone mapping, Simi Valley, California: Eos, Transactions of the American Geophysical Union, v. 77., n. 46, p. F510.

Hitchcock, C.S., R.C. Loyd and W.D. Haydon, in press, Mapping liquefaction hazards in Simi Valley, Ventura County, California: Environmental & Engineering Science (joint publication of the Association of Engineering Geologists and the Geological Society of America).

Martin, G.R., M. Lew, K. Arulmoli, J. Baez, T. Blake, J. Earnest, F. Gharib, J. Goldhammer, D. Hsu, S. Kupferman, J. O'Tousa, C. Real, E. Simantob and T.L. Youd, in press, Recommended procedures for implementation of DMG SP 117 "Guidelines for evaluating and mitigating Seismic Hazards in California"—Liquefaction hazards: Southern California Earthquake Center, University of Southern California, Los Angeles, California.

McCrink, T.P., J.R. McMillan, J.P. Schlosser, M.A. Silva, R.I. Wilson, A.G. Barrows, P.J. Irvine, F.G. Perez and J.A. Trieman, 1988, Earthquake-induced landslide zone mapping in Southern California: Geological Society of America, Abstracts With Programs, Cordilleran Section, v. 30, n. 5, p. 54.

McMillan, Jack, Ted Smith, Tim McCrink, John Schlosser, Mike Silva, Wayne Hayden, Chris Wills and Rick Wilson, in press, Earthquake inputs to Bay Area planning: Fifth Annual California GIS Conference, Oakland, California, February 17-19, 1999.

Petersen, M.D. and C.H. Cramer, 1997, Assessing earthquake ground shaking hazard in California: California Geology, v. 50, n. 4, p. 107-115.

Petersen, M.D., W.A. Bryant, C.H. Cramer, T. Cao, M.S. Reichle, A.D. Frankel, J.J. Lienkaemper, P.A. McCroroy and D.P. Schwartz, 1996, Probabilistic seismic hazard assessment for the State of California: California Division of Mines and Geology Open-File Report 96-08, U.S. Geological Survey Open-File Report 96-706.

Petersen, M.D., W.A. Bryant, C.H. Cramer, M.S. Reichl, and C.R. Real, 1997, Seismic ground motion hazard mapping incorporating site effects for Los Angeles, Orange, and Ventura Counties, California—A geographical information system application: Bulletin of the Seismological Society of America, v. 87, p. 249-255.

Petersen, M.D., C.H. Cramer, W.A. Bryant, M.S. Reichle, and T.R. Toppozada, 1996, Preliminary seismic hazard assessment for Los Angeles, Ventura, and Orange

counties, California, Affected by the 17 January 1994 Northridge Earthquake, Bulletin of the Seismological Society of America, v. 86, n. 1B, p. S247-S261.

Petersen, Mark, Tousson Toppozada, Tianqing Cao, Chris Cramer. Michael Reichle, Margaret Maher and Larry Atchison, 1998, New geologic maps lend support to better building design in California earthquake country: California Geology, v. 51, n. 2, p. 3-9.

Real, Charles, 1998, Reducing future earthquake losses in California: California Geology, v. 51, n. 2, p. 10-14.

Real, C.R., in press, California's Seismic Hazards Mapping Act: Geoscience and Public Policy, *in* Babrowsky, ed., Geoenvironmental Mapping: Method, Theory and Practice: International Union of Geological Sciences.

Real, C.R. and J.F. Davis, 1997, Seismic zonation in California. Eos, Transactions of the American Geophysical Union, v. 78, n. 17, p.S51.

Real, C.R. and M.D. Petersen, 1994, Provisional seismic zoning of portions of Los Angeles and Ventura Counties following the 17 January 1994 Northridge earthquake, *in* M.C. Woods and W.R. Seiple, editors, The Northridge, California, earthquake of 17 January 1994: California Department of Conservation, Division of Mines and Geology Special Publication p. 116, p. 231-240.

Real C.R. and M.S. Reichle, 1995, An accelerated program for seismic zonation following the January 17, 1994 Northridge Earthquake. Proceedings of the 5th International Conference on Seismic Zonation, October 17-19, 1995, Nice,France, v. I, p. 895-902.

Real C. R. and M.S. Reichle, 1996, Un programme accéléré à la suite du séisme de Northridge. Responsabilité & Environnement, n. 3, p. 47-53.

Real, C.R., M.J. DeLisle and T.P. McCrink, 1996, Provisional seismic zoning for ground failures in portions of Los Angeles and Ventura counties following the January 17, 1994 Northridge Earthquake: Bulletin of the Seismological Society of America, v. 86, n. 1B, p. S262-S269.

Real, C.R., M.J. DeLisle, T.P. McCrink, R.B. Greenwood, P.J. Irvine, R. Loyd, J. McMillan, C. Pridmore, M. Silva, J.A. Treiman, M. Reichle and T.C. Smith, 1996, Reconnaissance seismic hazards maps of portions of Los Angeles and Ventura counties, California: California Department of Conservation, Division of Mines and Geology Open-File Report 96-01, 8 p., 16 maps (1:24,000 scale).

Real, Charles, Theodore Smith and James Davis, 1998, California's Seismic Hazard Mapping Program: Western States Seismic Policy Council, WSSPC Twentieth Annual Conference Program Guide and Policy Papers Volume, September 15-18, 1998, Pasadena, California, p. P-23.

Real, C.R., R.I. Wilson and T.P. McCrink, 1997, Suitability of airborne-radar topographic data for evaluating earthquake-induced ground failure hazards: Proceedings of the 12th International Conference on Applied Geologic Remote Sensing, November 17-19, Denver, Colorado, v. I, p. 133–140.

Smith, T.C. [Authorship incorrectly attributed to Michael Reichle], 1996, State seismic hazard mapping program update: SCEC Newsletter, Southern California Earthquake Center, Spring 1996.

Smith, T.C., 1996, Preliminary maps of seismic hazard zones and draft guidelines for evaluating and mitigating seismic hazards: California Geology, v. 49, n. 6., p. 147-150.

Smith, Ted and Bea McKamey, 1998, California Legislature revises disclosure requirements for earthquake fault zones and seismic hazard zones effective March 1, 1998: California Geology, v. 51, n. 2, p. 15.

Smith, T.C., B. McKamey, and C.R. Real, 1998, The Importance of state and local communication in California's Seismic Hazard Mapping Program: Association of Engineering Geologists, Annual Meeting Abstracts, Seattle, WA, October 1998.

State Mining and Geology Board, 1997, Guidelines for evaluating and mitigating seismic hazards in California: California Department of Conservation, Division of Mines and Geology Special Publication 117, 74 p.

Wills, C.G., 1996, Liquefaction in the California desert—An unexpected geologic hazard: California Geology, v. 49, n. 2, p. 31-35.

Wills, C.J. and W. Silva, 1998, Shear wave velocity characteristics of geologic units in California: Earthquake Spectra, v.14, p. 533-556.

Wilson, R. I., T. P. McCrink, and C. R. Real, 1997, Application of interferometric synthetic aperture radar digital elevation models for earthquake-induced landslide hazard mapping in Southern California; poster presentation at Association of Engineering Geologists Annual Meeting, Portland, OR.

Wilson, R. I., E. M. Oatney, C. R. Real, T. P. McCrink, and W. D. Haydon, 1995, Analysis and application of an airborne interferometric synthetic aperture radar-produced digital elevation model for use in seismic hazards evaluation; poster presentation at Association of Engineering Geologists Annual Meeting, Sacramento, CA.

Appendix 4–List of Evaluation Reports Documenting Data and Zoning Criteria

APPENDIX 4

List of Evaluation Reports Documenting Data and Zoning Criteria Used to Produce Seismic Hazard Zone Maps

QUADRANGLE NAME	DMG OPEN-FILE REPORT NUMBER	QUADRANGLE NAME	DMG OPEN-FILE REPORT NUMBER
Anaheim	97-08	Oat Mountain	97-12
Azusa	98-12	Orange	97-19
Baldwin Park	98-13	Pasadena	98-05
Beverly Hills	98-14	Redondo Beach	98-22
Burbank	98-07	San Dimas	98-23
Calabasas	97-13	San Fernando	98-06
Canoga Park	97-14	San Francisco North	97-05
El Monte	98-15	San Pedro	98-24
Glendora	98-16	Seal Beach	98-11
Hollywood	98-17	Simi Valley East	97-07
Inglewood	98-18	Simi Valley West	97-07
La Habra	97-17	South Gate	98-25
Laguna Beach	97-21	Sunland	98-08
Long Beach	98-19	Topanga	97-06
Los Alamitos	98-10	Torrance	98-26
Los Angeles	98-20	Tustin	97-20
Mint Canyon	98-09	Van Nuys	97-15
Mt. Wilson	98-21	Venice	98-27
Newhall	97-11	Whittier	98-28
Newport Beach	97-08	Yorba Linda	97-18

APPENDIX 5

Meeting Handouts

Seismic Hazard Mapping Act

STATE OF CALIFORNIA
Department of Conservation
Division of Mines and Geology

Web Site:
http://www.consrv.ca.gov/dmg/shezp/

Laws and Regulations

- **Seismic Hazards Mapping Act** (Public Resources Code, Chapter 7.8)
- **Seismic Hazards Mapping Regulations** (California Code of Regulations, Article 10)
- **Earthquake Fault Zoning Act** (Public Resources Code, Chapter 7.5)
  - Definition of "project" (Section 2621).
- **Strong Motion Instrumentation Program** (Public Resources Code, Chapter 8)
  - Building permit fee collection (Section 2705)
  - Fee retention provisions (Section 2705 (c))

Visit Objective

- Establish open line of communication
- Provide information on requirements of Seismic Hazard Mapping Act
- Deliver advance copy of maps being released for review and comment and describe how official maps will be released
- Identify primary contact for city/county
- Provide information about resources available from DMG

Significant Events

- **1971 -- San Fernando Earthquake**

  A-P mapping program authorized to reduce future earthquake losses

- **1989 -- Loma Prieta Earthquake**

  Mapping of other seismic hazards authorized to reduce future earthquake losses. Funding from building fees and California Residential Earthquake Recovery Fund (CRERF)

- **1990 -- CRERF repealed**

- **1994 -- Northridge Earthquake**

  FEMA/OES funds mapping of liquefaction and landslides hazards in 38 quadrangles in Los Angeles, Orange, and Ventura counties.

Significant Events

1997 -- First Maps Released

- The first Official Hazard Zone Maps were released in April
- Evaluation and mitigation guidelines were adopted by the State Mining and Geology Board in March 1997.

Seismic Hazard Mapping Act

Purpose -- To reduce future earthquake losses and facilitate informed decisions through:

- Hazard identification
- Site verification
- Hazard mitigation
- Disclosure

CALIFORNIA PUBLIC RESOURCES CODE

Division 2. Geology, Mines and Mining

CHAPTER 7.8
SEISMIC HAZARDS MAPPING

Last Updated: 06/11/98

Chapter 7.8 Index

- 2690. Citation of chapter
- 2691. Legislative findings and declaration
- 2692. Additional legislative intent
- 2692.1. Tsunami and seiche information; distribution
- 2693. Definitions
- 2694. Disclosure by property seller or agent
- 2695. Development of guidelines, priorities, policies, and criteria
- 2696. Maps: Preparation, distribution, and notice
- 2697. City and county responsibilities; geotechnical reports; waiver or approval; submission of copies
- 2698. City or county policies and criteria may be stricter
- 2699. Use of map information in safety elements and ordinances
- 2699.5. Seismic Hazards Identification Fund
- 2699.6. Operative date of chapter

NOTE: You may also obtain the text of this code from the California Legislative Analyst's web site.

CHAPTER 7.8
SEISMIC HAZARDS MAPPING

2690. Citation of chapter

This chapter shall be known and may be cited as the Seismic Hazards Mapping Act.

2691. Legislative findings and declaration

The Legislature finds and declares all of the following:

(a) The effects of strong ground shaking, liquefaction, landslides, or other ground failure account for approximately 95 percent of economic losses caused by an earthquake.

(b) Areas subject to these processes during an earthquake have not been identified or mapped statewide, despite the fact that scientific techniques are available to do so.

(c) It is necessary to identify and map seismic hazard zones in order for cities and counties to adequately prepare the safety element of their general plans and to encourage land use management policies and regulations to reduce and mitigate those hazards to protect public health and safety.

2692. Additional legislative intent

(a) It is the intent of the Legislature to provide for a statewide seismic hazard mapping and technical advisory program to assist cities and counties in fulfilling their responsibilities for protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure and other seismic hazards caused by earthquakes.

(b) It is further the intent of the Legislature that maps and accompanying information provided pursuant to this chapter be made available to local governments for planning and development purposes.

(c) It is further the intent of the Legislature that the Division of Mines and Geology, in implementing this chapter, shall, to the extent possible, coordinate its activities with, and use existing information generated from, the earthquake fault zones mapping program pursuant to Chapter 7.5 (commencing with Section 2621), the landslide hazard identification program pursuant to Chapter 7.7 (commencing with Section 2670), and the inundation maps prepared pursuant to Section 8589.5 of the Government Code.

2692.1. Tsunami and seiche information; distribution

The State Geologist may include in maps compiled pursuant to this chapter information on the potential effects of tsunami and seiche when information becomes available from other sources and the State Geologist determines the information is appropriate for use by local government. The State Geologist shall not be required to provide this information unless additional funding is provided both to make the determination and to distribute the tsunami and seiche information.

2693. Definitions

As used in this chapter:

(a) "City" and "county" includes the City and County of San Francisco.

(b) "Geotechnical report" means a report prepared by a certified engineering geologist or a civil engineer practicing within the area of his or her competence, which identifies seismic hazards and recommends mitigation measures to reduce the risk of seismic hazard to acceptable levels.

(c) "Mitigation" means those measures that are consistent with established practice and that will reduce seismic risk to acceptable levels.

(d) "Project" has the same meaning as in Chapter 7.5 (commencing with Section 2621), except as follows:

(1) A single-family dwelling otherwise qualifying as a project may be exempted by the city or county having jurisdiction of the project.

(2) "Project" does not include alterations or additions to any structure within a seismic hazard zone which do not exceed either 50 percent of the value of the structure or 50 percent of the existing floor area of the structure.

(e) "Commission" means the Seismic Safety Commission.

(f) "Board" means the State Mining and Geology Board.

2694. Disclosure by property seller or agent

(a) A person who is acting as an agent for a seller of real property that is located within a seismic hazard zone, as designated under this chapter, or the seller, if he or she is acting without an agent, shall disclose to any prospective purchaser the fact that the property is located within a seismic hazard zone.

(b) In all transactions that are subject to Section 1102 of the Civil Code, the disclosure required by subdivision (a) of this section shall be provided by either of the following means:

(1) The Local Option Real Estate Transfer Disclosure Statement as provided in Section 1102.6a of the Civil Code.

(2) The Natural Hazard Disclosure Statement as provided in Section 1102.6c of the Civil Code.

(c) Disclosure is required pursuant to this section only when one of the following conditions is met:

(1) The seller, or seller's agent, has actual knowledge that the property is within a seismic hazard zone.

(2) A map that includes the property has been provided to the city or county pursuant to Section 2622, and a notice has been posted at the offices of the county recorder, county assessor, and county planning agency that identifies the location

recorder, county assessor, and county planning agency that identifies the location of the map and any information regarding changes to the map received by the county.

(d) If the map or accompanying information is not of sufficient accuracy or scale that a reasonable person can determine if the subject real property is included in a seismic hazard zone, the agent shall mark "Yes" on the Natural Hazard Disclosure Statement. The agent may mark "No" on the Natural Hazard Disclosure Statement if he or she attaches a report prepared pursuant to subdivision (c) of Section 1102.4 of the Civil Code that verifies the property is not in the hazard zone. Nothing in this subdivision is intended to limit or abridge any existing duty of the seller or the seller's agents to exercise reasonable care in making a determination under this subdivision.

(e) For purposes of the disclosures required by this section, the following persons shall not be deemed agents of the seller:

(1) Persons specified in Section 1102.11 of the Civil Code.

(2) Persons acting under a power of sale regulated by Section 2924 of the Civil Code.

(f) For purposes of this section, Section 1102.13 of the Civil Code applies.

(g) The specification of items for disclosure in this section does not limit or abridge any obligation for disclosure created by any other provision of law or that may exist in order to avoid fraud, misrepresentation, or deceit in the transfer transaction.

2695. Development of guidelines, priorities, policies, and criteria

(a) On or before January 1, 1992, the board, in consultation with the director and the commission, shall develop all of the following:

(1) Guidelines for the preparation of maps of seismic hazard zones in the state.

(2) Priorities for mapping of seismic hazard zones. In setting priorities, the board shall take into account the following factors:

(A) The population affected by the seismic hazard in the event of an earthquake.

(B) The probability that the seismic hazard would threaten public health and safety in the event of an earthquake.

(C) The willingness of lead agencies and other public agencies to share the cost of mapping within their jurisdiction.

(D) The availability of existing information.

(3) Policies and criteria regarding the responsibilities of cities, counties, and state agencies pursuant to this chapter. The policies and criteria shall address, but not be limited to, the following:

limited to, the following:

(A) Criteria for approval of a project within a seismic hazard zone, including mitigation measures.

(B) The contents of the geotechnical report .

(C) Evaluation of the geotechnical report by the lead agency.

(4) Guidelines for evaluating seismic hazards and recommending mitigation measures.

(5) Any necessary procedures, including, but not limited to, processing of waivers pursuant to Section 2697, to facilitate the implementation of this chapter.

(b) In developing the policies and criteria pursuant to subdivision (a), the board shall consult with and consider the recommendations of an advisory committee, appointed by the board in consultation with the commission, composed of the following members:

(1) An engineering geologist registered in the state.

(2) A seismologist.

(3) A civil engineer registered in the state.

(4) A structural engineer registered in the state.

(5) A representative of city government, selected from a list submitted by the League of California Cities.

(6) A representative of county government, selected from a list submitted by the County Supervisors Association of California.

(7) A representative of regional government, selected from a list submitted by the Council of Governments.

(8) A representative of the insurance industry.

(9) The Insurance Commissioner.

All of the members of the advisory committee shall have expertise in the field of seismic hazards or seismic safety.

(c) At least 90 days prior to adopting measures pursuant to this section, the board shall transmit or cause to be transmitted a draft of those measures to affected cities, counties, and state agencies for review and comment.

2696. Maps: Preparation, distribution, and notice

(a) The State Geologist shall compile maps identifying seismic hazard zones, consistent with the requirements of Section 2695. The maps shall be compiled in accordance with a time schedule developed by the director and based upon the

provisions of Section 2695 and the level of funding available to implement this chapter.

(b) The State Geologist shall, upon completion, submit seismic hazard maps compiled pursuant to subdivision (a) to the board and all affected cities, counties, and state agencies for review and comment. Concerned jurisdictions and agencies shall submit all comments to the board for review and consideration within 90 days. Within 90 days of board review, the State Geologist shall revise the maps, as appropriate, and shall provide copies of the official maps to each state agency, city, or county, including the county recorder, having jurisdiction over lands containing an area of seismic hazard. The county recorder shall record all information transmitted as part of the public record.

(c) In order to ensure that sellers of real property and their agents are adequately informed, any county that receives an official map pursuant to this section shall post a notice within five days of receipt of the map at the office of the county recorder, county assessor, and county planning agency, identifying the location of the map and any information regarding changes to the map and the effective date of the notice.

2697. City and county responsibilities; geotechnical reports; waiver or approval; submission of copies

(a) Cities and counties shall require, prior to the approval of a project located in a seismic hazard zone, a geotechnical report defining and delineating any seismic hazard. If the city or county finds that no undue hazard of this kind exists, based on information resulting from studies conducted on sites in the immediate vicinity of the project and of similar soil composition to the project site, the geotechnical report may be waived . After a report has been approved or a waiver granted, subsequent geotechnical reports shall not be required, provided that new geologic datum, or data, warranting further investigation is not recorded. Each city and county shall submit one copy of each approved geotechnical report, including the mitigation measures, if any, that are to be taken, to the State Geologist within 30 days of its approval of the report.

(b) In meeting the requirements of this section, cities and counties shall consider the policies and criteria established pursuant to this chapter. If a project's approval is not in accordance with the policies and criteria, the city or county shall explain the reasons for the differences in writing to the State Geologist, within 30 days of the project's approval.

2698. City or county policies and criteria may be stricter

Nothing in this chapter is intended to prevent cities and counties from establishing policies and criteria which are more strict than those established by the board.

2699. Use of map information in safety elements and ordinances

Each city and county, in preparing the safety element to its general plan pursuant to subdivision (g) of Section 65302 of the Government Code, and in adopting or

to subdivision (g) of Section 65302 of the Government Code, and in adopting or revising land use planning and permitting ordinances, shall take into account the information provided in available seismic hazard maps.

2699.5. Seismic Hazards Identification Fund

(a) There is hereby created the Seismic Hazards Identification Fund, as a special fund in the State Treasury. Notwithstanding Section 13340 of the Government Code, the moneys in the fund are continuously appropriated to the division for the purposes of this chapter.

(b) Notwithstanding Section 5001 of the Insurance Code, one-half of 1 percent of the earthquake surcharge moneys received by the California Residential Earthquake Recovery Fund in any calendar year shall be transferred to the Seismic Hazards Identification Fund for the purposes of carrying out this chapter. This subdivision shall become operative only if Assembly Bill 3913 or Senate Bill 2902 of the 1989-90 Regular Session of the Legislature is enacted and takes effect.

2699.6. Operative date of chapter

This chapter shall become operative on April 1, 1991.

Click here to return to Chapter 7.8 Index

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CALIFORNIA CODE OF REGULATIONS

Title 14. Natural Resources

Division 2. Department of Conservation

Chapter 8. Mining and Geology

ARTICLE 10
SEISMIC HAZARDS MAPPING

- 3720. Purpose
- 3721. Definitions
- 3722. Requirements for Mapping Seismic Hazards Zones
- 3723. Review of Preliminary Seismic Hazards Zone Maps
- 3724. Specific Criteria for Project Approval
- 3725. Waivers of Geotechnical Report Requirments

3270. Purpose

These regulations shall govern the exercise of city, county and state agency responsibilities to identify and map seismic hazard zones and to mitigate seismic hazards to protect public health and safety in accordance with the provisions of
Public Resources Code, Section 2690 et seq. (Seismic Hazards Mapping Act).

Authority cited: **Public Resources Code Section 2695**
Reference: **Public Resources Code Section 2695(a)(1)and (3)-(5)**

3271. Definitions

(a) "Acceptable Level" means that level that provides reasonable protection of the public

safety, though it does not necessarily ensure continued structural integrity and functionality of the project.

(b) "Lead Agency" means the city, county or state agency with the authority to approve projects.

(c) "Registered civil engineer" or "certified engineering geologist" means a civil engineer or engineering geologist who is registered or certified in the State of California.

Authority cited: **Public Resources Code Section 2695**
Reference: **Public Resources Code Sections 2690-2696.6**

3722. Requirements for Mapping Seismic Hazard Zones

(a) The Department of Conservation, Division of Mines and Geology, shall prepare one or more State-wide probabilistic ground shaking maps for a suitably defined reference soil column. One of the maps shall show ground shaking levels which have a 10% probability of being exceeded in 50 years. These maps shall be used with the following criteria to define seismic hazard zones:

(1) Amplified shaking hazard zones shall be delineated as areas where historic occurrence of amplified ground shaking, or local geological and geotechnical conditions indicate a potential for ground shaking to be amplified to a level such that mitigation as defined in **Public Resources Code Section 2693(c)** would be required.

(2) Liquefaction hazard zones shall be delineated as areas where historic occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in **Public Resources Code Section 2693(c)** would be required.

(3) Earthquake-induced landslide hazard zones shall be delineated as areas where Holocene occurrence of landslide movement, or local slope of terrain, and geological, geotechnical and ground moisture conditions indicate a potential for permanent ground displacements such that mitigation as defined in **Public Resources Code Section 2693(c)** would be required.

(b) Highest priority for mapping seismic hazard zones shall be given to areas facing urbanization or redevelopment in conjunction with the factors listed in **Section 2695(a)(2)(A), (B), (C) and (D) of the Public Resources Code.**

Authority cited: **Public Resources Code Section 2695**
Reference: **Public Resources Code Section 2695(a)(1)**

3723. Review of Preliminary Seismic Hazard Zones Maps

(a) The Mining and Geology Board shall provide an opportunity for receipt of public comments and recommendations during the 90-day period for review of preliminary seismic hazard zone maps provided by the **Public Resources Code Section 2696.** At

least one public hearing shall be scheduled for that purpose.

(b) Following the end of the review period, the Board shall forward its comments and recommendations, with supporting data received, to the State Geologist for consideration prior to revision and official issuance of the maps.

Authority cited: **Public Resources Code Section 2696**
Reference: **Public Resources Code Section 2696**

3724. Specific Criteria for Project Approval

The following specific criteria for project approval shall apply within seismic hazard zones and shall be used by affected lead agencies in complying with the provisions of the Act:

(a) A project shall be approved only when the nature and severity of the seismic hazards at the site have been evaluated in a geotechnical report and appropriate mitigation measures have been proposed.

(b) The geotechnical report shall be prepared by a registered civil engineer or certified engineering geologist, having competence in the field of seismic hazard evaluation and mitigation. The geotechnical report shall contain site-specific evaluations of the seismic hazard affecting the project, and shall identify portions of the project site containing seismic hazards. The report shall also identify any known off-site seismic hazards that could adversely affect the site in the event of an earthquake. The contents of the geotechnical report shall include, but shall not be limited to, the following:

(1) Project description.

(2) A description of the geologic and geotechnical conditions at the site, including an appropriate site location map.

(3) Evaluation of site-specific seismic hazards based on geological and geotechnical conditions, in accordance with current standards of practice.

(4) Recommendations for appropriate mitigation measures as required in **Section 3724(a),** above.

(5) Name of report preparer(s), and signature(s) of a certified engineering geologist and/or registered civil engineer, having competence in the field of seismic hazard evaluation and mitigation.

(c) Prior to approving the project, the lead agency shall independently review the geotechnical report to determine the adequacy of the hazard evaluation and proposed mitigation measures and to determine the requirements of **Section 3724(a),** above, are satisfied. Such reviews shall be conducted by a certified engineering geologist or registered civil engineer, having competence in the field of seismic hazard evaluation and mitigation.

Authority cited: **Public Resources Code Section 2695**
Reference: **Public Resources Code Section 2695(a)(3)(A), (B), and (C)**

3725. Waivers of Geotechnical Report Requirements

For a specific project, the lead agency may determine that the geological and geotechnical conditions at the site are such that public safety is adequately protected and no mitigation is required. This finding shall be based on a report presenting evaluations of sites in the immediate vicinity having similar geologic and geotechnical characteristics. The report shall be prepared by a certified engineering geologist or register civil engineer, having competence in the field of seismic hazard evaluation and mitigation. The lead agency shall review submitted reports in the same manner as in **Section 3724(c)** of this article. The lead agency shall also provide a written commentary that addresses the report conclusions and the justification for applying the conclusions contains in the report to the project site. When the lead agency makes such a finding, it may waive the requirement of a geotechnical report for the project. All such waivers shall be recorded with the county recorded and a separate copy, together with the report and commentary, filed with the State Geologist within 30 days of the waiver.

Authority cited: **Public Resources Code Section 2695**
Reference: **Public Resources Code Section 2697(a)(5)**

Return to **Article 10 index**

Jump to HOME PAGE for: | **DOC** | **DMG** | **SHEZP** |

Local Government Mandates

SHMA and CCR Requirements

- Determine need for site investigation report
- Require site investigation report for certain properties prior to permitting development
- Review and accept site investigation report per criteria for project approval (see CCR Section 3724)
- Provide a copy of the site investigation report to the State Geologist

Local Government Mandates

SHMA (continued)

- Use information on zone maps in preparing safety elements and adopting and revising land-use planning and permitting ordinances
- Counties responsible for posting a notice that seismic hazard zone maps are in effect and available
- County recorder must record official maps

Property Owner/ Seller Mandate

Property owners (or their agents)

- Must disclose prior to sale whether property is located in a seismic hazard zone.

Map Criteria and Potential Effects

■ Liquefaction

- Historic high water table within 40-feet of surface
- Loose sands and silts
- Example of damage
  - » Nagata, Japan*

■ Lateral spreading

- Liquefiable zones near stream channels, cuts and other open faces
- Examples of damage
  - » Moss Landing*
  - » Kings Harbor*

***See photos of examples in the draft User's Guide**

Map Criteria and Potential Effects

Map criteria (continued)

- **Earthquake-induced landslides**
  - Steep slopes, known landslide deposits and features, and weak rock
  - Example of damage
    - » Pacific Palisades*

***See photos of examples in the draft User's Guide**

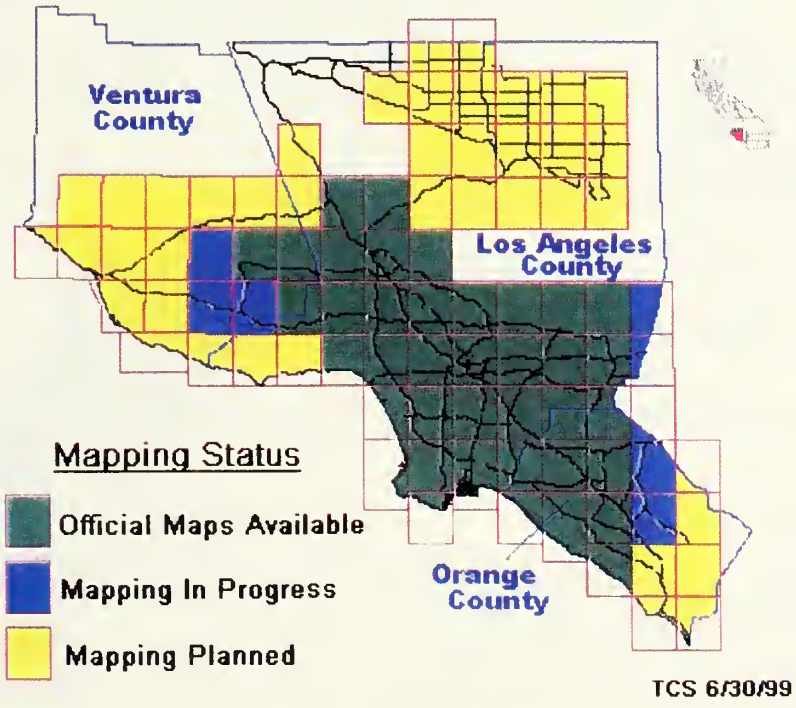
Department of Conservation

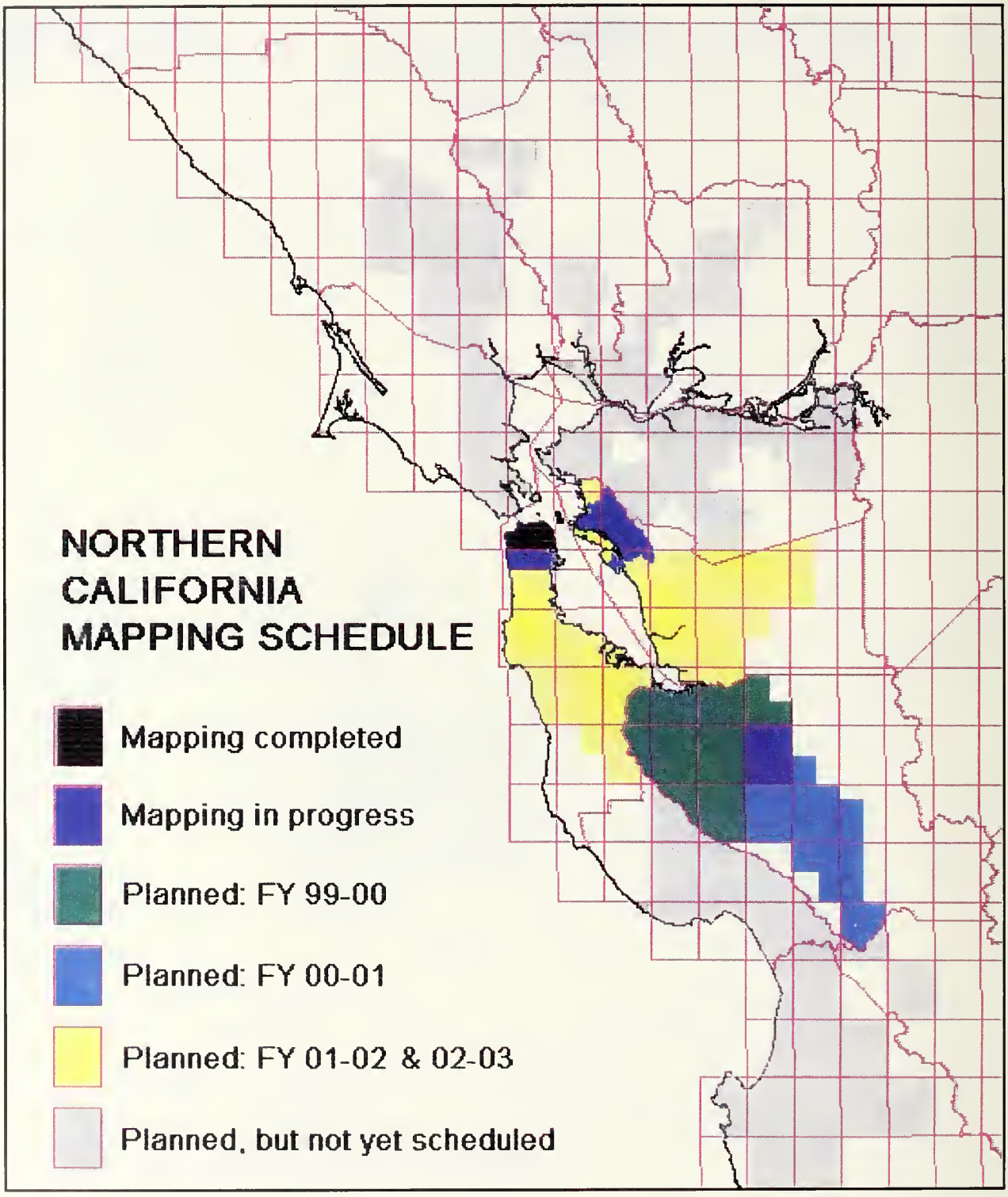
Division of Mines and Geology

SEISMIC HAZARD ZONE MAP STATUS

As of July 19, 1999

The map below indicates the status of Seismic Hazard Zone Maps for parts of Los Angeles, Orange, and Ventura Counties. Each small rectangle outlined in red represents one U.S. Geological Survey 7.5-minute quadrangle (the standard base map on which the zones are plotted). It is likely that the maps currently in production will be released for review in late 1999. Remaining maps will be made available during the next four years. In general, plans call for completion of maps in Orange, Ventura, and westernmost Los Angeles counties prior to mapping the Palmdale-Lancaster region.




NORTHERN
CALIFORNIA
MAPPING SCHEDULE
Mapping completed
Mapping in progress
Planned: FY 99-00
Planned: FY 00-01
Planned: FY 01-02 & 02-03
Planned, but not yet scheduled

Map Review Schedule

- **90-day review and comment period**

  Send comments to:

  Mining and Geology Board
  801 K Street, MS 24-05
  Sacramento, CA 95814

- **DMG has 90-days following close of comment period to revise maps**

- **Official maps issued approximately 6-months after release of preliminary maps**

User's Guide

■ Mitigation

- Foundation strengthening
  - » Piles
  - » Reinforcement
- Water management
  - » Lower water table
- Site improvement
  - » Compaction
  - » Landslide removal
  - » Retaining walls
  - » Debris diversion

For more information in mitigation techniques, refer to "***Guidelines for Evaluating and Mitigating Seismic Hazards in California***."

CALIFORNIA PUBLIC RESOURCES CODE

Division 2. Geology, Mines and Mining

CHAPTER 7.5
EARTHQUAKE FAULT ZONING

Last Updated: 06/11/98

Chapter 7.5 Index

- 2621. Citation of chapter
- 2621.5. Purpose and application of chapter
- 2621.6. Project defined
- 2621.7. Exception as to conversion of apartment complex into condominium: projects included
- 2621.8. Exception as to alterations or additions not exceeding 50 percent of value
- 2621.9. Disclosure to prospective purchaser that property is located within zone
- 2622. Functions of the State Geologist, cities and counties
- 2623. Approval of project by city or county: Policies and criteria
- 2624. Authority reserved to cities and counties; regulations, fees, and exemptions
- 2625. Fees: Standard for geologic report
- 2626-2629. [No sections of these numbers]
- 2630. Advice of seismic safety commission

NOTE: You may also obtain the text of this code from the California Legislative Analyst's web site.

CHAPTER 7.5
EARTHQUAKE FAULT ZONING

2621. Citation of chapter

This chapter shall be known, and may be cited, as the Alquist-Priolo Earthquake Fault Zoning Act.

2621.5. Purpose and application of chapter

(a) It is the purpose of this chapter to provide for the adoption and administration of zoning laws, ordinances, rules, and regulations by cities and counties in implementation of the general plan that is in effect in any city or county. The Legislature declares that this chapter is intended to provide policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibility to prohibit the location of developments and structures for human occupancy across the trace of active faults. Further, it is the intent of this chapter to provide the citizens of the state with increased safety and to minimize the loss of life during and immediately following earthquakes by facilitating seismic retrofitting to strengthen buildings, including historical buildings, against ground shaking.

(b) This chapter is applicable to any project, as defined in Section 2621.6 , which is located within a delineated earthquake fault zone, upon issuance of the official earthquake fault zones maps to affected local jurisdictions, except as provided in Section 2621.7 .

(c) The implementation of this chapter shall be pursuant to policies and criteria established and adopted by the board.

2621.6. Project defined

(a) As used in this chapter, "project" means either of the following:

(1) Any subdivision of land which is subject to the Subdivision Map Act (Division 2 (commencing with Section 66410) of Title 7 of the Government Code), and which contemplates the eventual construction of structures for human occupancy.

(2) Structures for human occupancy, with the exception of either of the following:

(A) Single-family wood-frame or steel-frame dwellings to be built on parcels of land for which geologic reports have been approved pursuant to paragraph (1).

(B) A single-family wood-frame or steel-frame dwelling not exceeding two stories when that dwelling is not part of a development of four or more dwellings.

(b) For the purposes of this chapter, a mobilehome whose body width exceeds eight feet shall be considered to be a single-family wood-frame dwelling not exceeding two stories.

2621.7. Exception as to conversion of apartment complex into condominium: Projects included

This chapter, except Section 2621.9, shall not apply to any of the following:

(a) The conversion of an existing apartment complex into a condominium.

(a) The conversion of an existing apartment complex into a condominium.

(b) Any development or structure in existence prior to May 4, 1975, except for an alteration or addition to a structure that exceeds the value limit specified in subdivision (c).

(c) An alteration or addition to any structure if the value of the alteration or addition does not exceed 50 percent of the value of the structure.

(d) (1) Any structure located within the jurisdiction of the City of Berkeley or the City of Oakland which was damaged by fire between October 20, 1991, and October 23, 1991, if granted an exemption pursuant to this subdivision.

(2) The city may apply to the State Geologist for an exemption and the State Geologist shall grant the exemption only if the structure located within the earthquake fault zone is not situated upon a trace of an active fault line, as delineated in the official earthquake fault zone map or in more recent geologic data, as determined by the State Geologist.

(3) When requesting an exemption, the city shall submit to the State Geologist all of the following information:

(A) Maps noting the parcel numbers of proposed building sites that are at least 50 feet from an identified fault and a statement that there is not any more recent information to indicate a geologic hazard.

(B) Identification of any sites that are within 50 feet of an identified fault.

(C) Proof that the property owner has been notified that the granting of an exemption is not any guarantee that a geologic hazard does not exist.

(4) The granting of the exemption does not relieve a seller of real property or an agent for the seller of the obligation to disclose to a prospective purchaser that the property is located within a delineated earthquake fault zone, as required by Section 2621.9.

(e) (1) Alterations which include seismic retrofitting, as defined in Section 8894.2 of the Government Code, to any of the following listed types of buildings in existence prior to May 4, 1975:

(A) Unreinforced masonry buildings, as described in subdivision (a) of Section 8875 of the Government Code.

(B) Concrete tilt-up buildings, as described in Section 8893 of the Government Code.

(C) Reinforced concrete moment resisting frame buildings as described in Applied Technology Council Report 21 (FEMA Report 154).

(2) The exemption granted by paragraph (1) shall not apply unless a city or county acts in accordance with all of the following:

(A) The building permit issued by the city or county for the alterations authorizes no greater human occupancy load, regardless of proposed use, than that authorized

no greater human occupancy load, regardless of proposed use, than that authorized for the existing use permitted at the time the city or county grants the exemption. This may be accomplished by the city or county making a human occupancy load determination that is based on, and no greater than, the existing authorized use, and including that determination on the building permit application as well as a statement substantially as follows: "Under subparagraph (A) of paragraph (2) of subdivision (e) of Section 2621.7 of the Public Resources Code, the occupancy load is limited to the occupancy load for the last lawful use authorized or existing prior to the issuance of this building permit, as determined by the city or county."

(B) The city or county requires seismic retrofitting, as defined in Section 8894.2 of the Government Code, which is necessary to strengthen the entire structure and provide increased resistance to ground shaking from earthquakes.

(C) Exemptions granted pursuant to paragraph (1) are reported in writing to the State Geologist within 30 days of the building permit issuance date.

(3) Any structure with human occupancy restrictions under subparagraph (A) of paragraph (2) shall not be granted a new building permit that allows an increase in human occupancy unless a geologic report, prepared pursuant to subdivision (d) of Section 3603 of Title 14 of the California Code of Regulations in effect on January 1, 1994, demonstrates that the structure is not on the trace of an active fault, or the requirement of a geologic report has been waived pursuant to Section 2623 .

(4) A qualified historical building within an earthquake fault zone that is exempt pursuant to this subdivision may be repaired or seismically retrofitted using the State Historical Building Code, except that, notwithstanding any provision of that building code and its implementing regulations, paragraph (2) shall apply.

2621.8. Exemptions; local agency liability

Notwithstanding Section 818.2 of the Government Code, a city or county which knowingly issues a permit that grants an exemption pursuant to subdivision (e) of Section 2621.7 that does not adhere to the requirements of paragraph (2) of subdivision (e) of Section 2621.7, may be liable for earthquake-related injuries or deaths caused by its failure to so adhere.

2621.9. Disclosure to prospective purchaser that property is located within zone

(a) A person who is acting as an agent for a seller of real property that is located within a delineated earthquake fault zone, or the seller, if he or she is acting without an agent, shall disclose to any prospective purchaser the fact that the property is located within a delineated earthquake fault zone.

(b) In all transactions that are subject to Section 1102 of the Civil Code, the disclosure required by subdivision (a) of this section shall be provided by either of the following means:

(1) The Local Option Real Estate Transfer Disclosure Statement as provided in Section 1102.6a of the Civil Code.

(2) The Natural Hazard Disclosure Statement as provided in Section 1102.6c of the Civil Code.

Civil Code.

(c) Disclosure is required pursuant to this section only when one of the following conditions is met:

(1) The seller, or the seller's agent, has actual knowledge that the property is within a delineated earthquake fault zone.

(2) A map that includes the property has been provided to the city or county pursuant to Section 2622, and a notice has been posted at the offices of the county recorder, county assessor, and county planning agency that identifies the location of the map and any information regarding changes to the map received by the county.

(d) If the map or accompanying information is not of sufficient accuracy or scale that a reasonable person can determine if the subject real property is included in a delineated earthquake fault hazard zone, the agent shall mark "Yes" on the Natural Hazard Disclosure Statement. The agent may mark "No" on the Natural Hazard Disclosure Statement if he or she attaches a report prepared pursuant to subdivision (c) of Section 1102.4 of the Civil Code that verifies the property is not in the hazard zone. Nothing in this subdivision is intended to limit or abridge any existing duty of the seller or the seller's agents to exercise reasonable care in making a determination under this subdivision.

(e) For purposes of the disclosures required by this section, the following persons shall not be deemed agents of the seller:

(1) Persons specified in Section 1102.11 of the Civil Code.

(2) Persons acting under a power of sale regulated by Section 2924 of the Civil Code.

(f) For purposes of this section, Section 1102.13 of the Civil Code shall apply.

(g) The specification of items for disclosure in this section does not limit or abridge any obligation for disclosure created by any other provision of law or that may exist in order to avoid fraud, misrepresentation, or deceit in the transfer transaction.

2622. Functions of State Geologist, cities and counties

(a) In order to assist cities and counties in their planning, zoning, and building-regulation functions, the State Geologist shall delineate, by December 31, 1973, appropriately wide earthquake fault zones to encompass all potentially and recently active traces of the San Andreas, Calaveras, Hayward, and San Jacinto Faults, and such other faults, or segments thereof, as the State Geologist determines to be sufficiently active and well-defined as to constitute a potential hazard to structures from surface faulting or fault creep. The earthquake fault zones shall ordinarily be one-quarter mile or less in width, except in circumstances which may require the State Geologist to designate a wider zone.

(b) Pursuant to this section, the State Geologist shall compile maps delineating the

(b) Pursuant to this section, the State Geologist shall compile maps delineating the earthquake fault zones and shall submit those maps to all affected cities, counties, and state agencies, not later than December 31, 1973, for review and comment. Concerned jurisdictions and agencies shall submit all comments to the State Mining and Geology Board for review and consideration within 90 days. Within 90 days of that review, the State Geologist shall provide copies of the official maps to concerned state agencies and to each city or county having jurisdiction over lands lying within that zone.

(c) The State Geologist shall continually review new geologic and seismic data and shall revise the earthquake fault zones or delineate additional earthquake fault zones when warranted by new information. The State Geologist shall submit all revised maps and additional maps to all affected cities, counties, and state agencies for their review and comment. Concerned jurisdictions and agencies shall submit all comments to the State Mining and Geology Board for review and consideration within 90 days. Within 90 days of that review, the State Geologist shall provide copies of the revised and additional official maps to concerned state agencies and to each city or county having jurisdiction over lands lying within the earthquake fault zone.

(d) In order to ensure that sellers of real property and their agents are adequately informed, any county that receives an official map pursuant to this section shall post a notice within five days of receipt of the map at the offices of the county recorder, county assessor, and county planning commission, identifying the location of the map and the effective date of the notice.

2623. Approval of project by city or county: Policies and criteria

(a) The approval of a project by a city or county shall be in accordance with policies and criteria established by the State Mining and Geology Board and the findings of the State Geologist. In the development of those policies and criteria, the State Mining and Geology Board shall seek the comment and advice of affected cities, counties, and state agencies. Cities and counties shall require, prior to the approval of a project, a geologic report defining and delineating any hazard of surface fault rupture. If the city or county finds that no undue hazard of that kind exists, the geologic report on the hazard may be waived, with the approval of the State Geologist.

(b) After a report has been approved or a waiver granted, subsequent geologic reports shall not be required, provided that new geologic data warranting further investigations is not recorded.

(c) The preparation of geologic reports that are required pursuant to this section for multiple projects may be undertaken by a geologic hazard abatement district.

2624. Authority reserved to cities and counties; regulations, fees, and exemptions

Notwithstanding any provision of this chapter, cities and counties may do any of the following:

(1) Establish policies and criteria which are stricter than those established by this chapter.

chapter.

(2) Impose and collect fees in addition to those required under this chapter.

(3) Determine not to grant exemptions authorized under this chapter.

2625. Fees: Standard for geologic report

(a) Each applicant for approval of a project may be charged a reasonable fee by the city or county having jurisdiction over the project.

(b) Such fees shall be set in an amount sufficient to meet, but not to exceed, the costs to the city or county of administering and complying with the provisions of this chapter.

(c) The geologic report required by Section 2623 shall be in sufficient detail to meet the criteria and policies established by the State Mining and Geology Board for individual parcels of land.

2630. Advice of seismic safety commission

In carrying out the provisions of this chapter, the State Geologist and the board shall be advised by the Seismic Safety Commission.

Click here to return to Chapter 7.5 Index

NOTE: you may wish to check LegInfo to verify the current version of these code sections.

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Seismic Hazard Zones In California

» » » » » *DRAFT* « « « « «

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PREFACE

The purpose of the Seismic Hazards Mapping Act is to identify areas where earthquakes are likely to cause shaking, liquefaction, landslides, or other ground failure, and to regulate development so as to reduce future earthquake losses. In essence, the goal of the program is improve public safety through construction of safer homes and other buildings.

This User's Guide provides a general overview of the requirements of the Act. In it, we (1) outline the responsibilities of various governmental agencies and private parties, (2) describe the actions taken to date by the State Geologist, State Mining and Geology Board and related committees and working groups, (3) describe the Seismic Hazard Zone Maps and related products, and (4) discuss some of the questions and issues that have already been raised by cities, counties, geotechnical consultants, industry, and the public. Readers are cautioned new programs such as this are likely to be modified as various parties who attempt to implement the law raise questions and attempt to clarify uncertainties.

Information presented herein is based on in-house documents, publications of staff of the Division of Mines and Geology, and discussions with hundreds of local officials and other interested parties. The principal references are cited in the **list of references.** The assistance of Charles Real, Michael Reichle, and other program staff, and of Earl Hart who prepared a similar publication (Special Publication 42) that describes the Earthquake Fault Evaluation and Zoning Program is gratefully acknowledged.

INTRODUCTION

In an effort to minimize loss of life and damage to property after the disastrous San Fernando earthquake of 1971, the Legislature passed and the Governor signed the Alquist-Priolo Earthquake Fault Hazards Zones Act of 1972. Although the hazard identification and mitigation program required by the Alquist-Priolo Act has been very successful, it only addresses the hazard of surface fault rupture—a phenomenon that only accounts for a relatively small percentage of earthquake losses.

Prompted by the Loma Prieta and Whittier earthquakes, in 1990 the Seismic Hazards Mapping Act was enacted as Public Resources Code Division 2, Chapter 7.8, The intent of the Act is to address the other 95 percent of earthquake losses. The Act became operative on April 1, 1991.

Except for the specifics of the hazards addressed, the program and actions mandated by the Seismic Hazards Mapping Act closely resemble those of the Alquist-Priolo Act:

1. The State Geologist is required to delineate the various seismic hazards zones.
2. Cities and counties must:
   a. Regulate certain development "projects" within the zones.
   b. Withhold development permits for sites within the zones until geologic or soils investigations are conducted and appropriate mitigation measures are incorporated into development plans.
3. The State Mining and Geology Board must provide additional regulations to guide cities and counties in their implementation of the law (California Administrative Code, Title 14, Division 2, Chapter 8, Subchapter 1, Article 10).

A summary of the principal responsibilities and functions required by the Seismic Hazards Mapping Act are given in Table 1.

PROGRAM FOR EVALUATING AND ZONING SEISMIC HAZARDS

Requirements of the Act

Section 2696 of the Seismic Hazards Mapping Act requires the State Geologist to:

1. Compile maps identifying seismic hazard zones, for protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure and other seismic hazards caused by earthquakes.
2. Submit the compiled seismic hazard maps to all affected cities, counties, state agencies, and the State Mining and Geology Board for review and comment. Following this review, the State Geologist may revise the maps, as appropriate, and must provide Official Maps to affected cities, counties, and state agencies, and the appropriate county recorder.

These requirements constitute the basis for the State Geologist's seismic hazards mapping program and for many of the policies developed to implement the program.

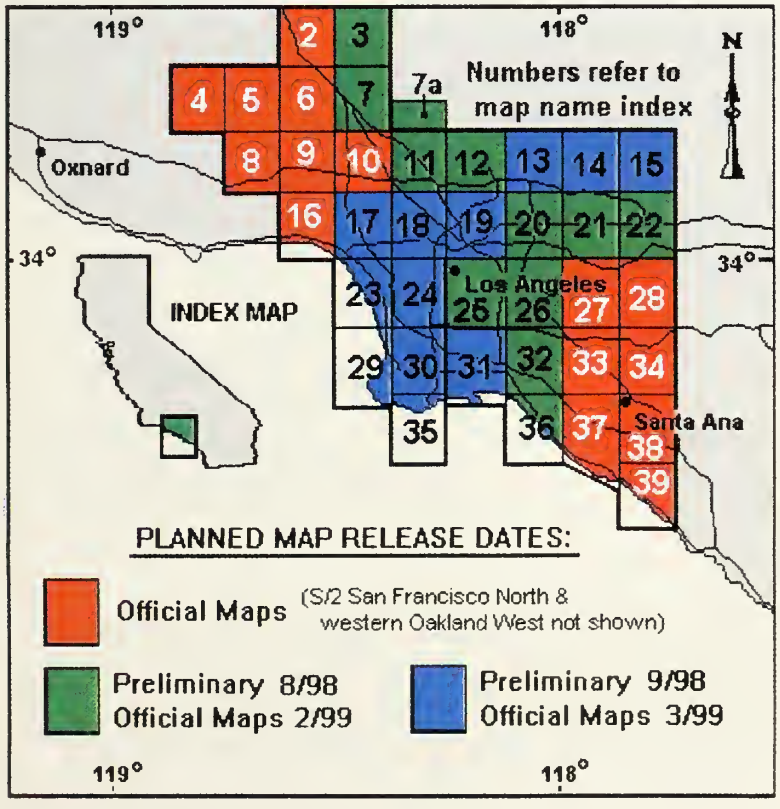
Program for Zoning Seismic Hazards

To facilitate the process of designating seismic hazards zones, the Division of Mines and Geology established the Seismic Hazard Evaluation and Zoning Project (SHEZP). When the program began, the stated goal was to zone the principal urban areas of California by the year 2000 and major growth areas by the year 2010, keeping pace with urbanization thereafter. However, funding limitations prevented completion of the task within that timeframe, and funding opportunities currently dictate the order in which areas have been and will be zoned.

Official seismic hazard zone maps are the product of a three-dimensional integration of geotechnical and geological data based on surface mapping and subsurface borings. The analysis is conducted according to Guidelines for Delineating Seismic Hazards Zones. These guidelines, adopted by the State Mining and Geology Board, were developed based on recommendations of an advisory committee and technical working groups comprised of numerous scientists and engineers having expertise in the field of earthquake hazards, including representatives of city, county, regional, and state government, the insurance industry, and the Insurance Commissioner, as specified in Section 2695(b) of the Seismic Hazards Mapping Act.

Methods employed to develop the maps include Youd and Perkins' (1978) liquefaction hazards mapping as applied by Tinsley and others (1985), Newmark's method for dynamic stability of slopes as adapted by Wilson and Keefer (1983) and Wieczorek and others (1985), and Carrara and others' multivariate terrain classification of slope stability. An advanced, geotechnically oriented geographic information system was developed and is used extensively in the testing, evaluation, and routine application of these hazard assessment methodologies (Real, 1993).

During the first year of the project, staff began compiling a liquefaction hazard zone map for part of the City of San Francisco as a pilot project. This pilot demonstrated that application of these methods at scales of 1:24,000 or larger is labor intensive because of the time required to collect the large volume of data and convert it to digital form. However, the GIS approach expedites modification of the maps as new data and/or analytical techniques become available. Digital zone maps can be used by cities and counties in their GIS to quickly identify and list affected properties. The raw digital data that is put into the system will be made available to other governmental agencies, private consultants, and others who need it to expedite site assessment and other tasks not necessarily related to this program.



After the seismic hazard zone maps are generated, they are distributed to cities, counties, and affected state agencies, and made available to the public for technical review and comment. Following the prescribed 90-day review period, the State Geologist has 90 days in which to issue the official maps. The first six maps were released in preliminary form on October 8, 1996 and as official maps on April 8, 1997. These six maps affect four counties and 20 cities (Table 2). As of June 1998, a total of 16 official maps have been released; 24 more maps are in production (Figure 1 and Table 2). Once these 24 new maps are released, more than 100 cities will be involved in the program.

Table 2. Cities/Counties Affected by Seismic Hazard Zone Maps As of April 15, 1998*

April 1997 Official Maps	February 1998 Official Maps	April 1998 Official Maps
Anaheim	Agoura Hills	Anaheim
Buena Park	Calabasas	Brea
Costa Mesa	Hidden Hills	Buena Park
Cypress	Los Angeles	Costa Mesa
Fountain Valley	Santa Clarita	Diamond Bar
Fullerton	Simi Valley	Fullerton
Garden Grove	Los Angeles County	Industry
Huntington Beach	Ventura County	Irvine
Los Angeles		Laguna Beach
Malibu		La Habra
Moorpark		La Habra Heights
Newport Beach		La Mirada
Orange		Los Angeles
Placentia		Newport Beach
San Francisco		Orange
Santa Ana		Placentia
Santa Monica		Santa Ana
Simi Valley		Tustin
Stanton		Villa Park
Westminster		Whittier
Los Angeles County		Yorba Linda
Orange County		Los Angeles County
Ventura County		Orange County

Definitions, Policies, and Rationale

Liquefaction and Liquefaction Hazard Zones

Liquefaction is a process by which water-saturated materials (including soil, sediment, and certain types of volcanic deposits) lose strength and may fail during strong ground shaking. Liquefaction is defined as "the transformation of a granular material from a solid state into a liquefied state as a consequence of increased pore-water pressure" (Youd, 1973, p. 1).

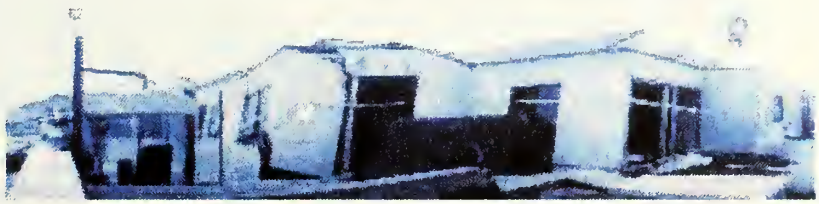
Liquefaction occurs worldwide, commonly during moderate to great earthquakes. In California, liquefaction-related ground failures occurred in 1857 (Fort Tejon earthquake), 1906 (San Francisco earthquake), 1933 (Long Beach earthquake), 1971 (San Fernando earthquake), 1973 (Point Mugu earthquake), 1979 and 1981 (Imperial Valley earthquakes), 1989 (Loma Prieta earthquake), and 1994 (Northridge earthquake), and others.

Four kinds of ground failure commonly result from liquefaction: lateral spread, flow failure, ground oscillation, and loss of bearing strength.

Lateral Spread

Lateral displacement of surficial blocks of sediment as the result of liquefaction in a subsurface layer is called a *lateral spread*. Once liquefaction transforms the subsurface layer into a fluidized mass, gravity plus inertial forces that result from the earthquake may cause the mass to move downslope towards a cut slope or free face (such as a river channel or a canal). Lateral spreads most commonly occur on gentle slopes that range between 0.3° and 3°, and commonly displace the surface by several meters to tens of meters. Such movement typically damages pipelines, utilities, bridges, and other structures having shallow foundations. During the 1906 San Francisco earthquake, lateral spreads causing displacement of only a few feet damaged every major pipeline that broke. Thus, liquefaction compromised the ability to fight the fires that caused about 85 percent of the damage to San Francisco.

A lateral spread triggered by the 1989 Loma Prieta earthquake damaged the Moss Landing Marine Laboratory (MLML) beyond repair.



The floor cracked, exposing utility lines; and the hallways became almost impassable. The structure was later demolished and the site was abandoned as unsuitable.

See http://color.mlml.calstate.edu/www/intro/mlconstr.htm for a more complete description of the events and damage at MLML.

Flow Failure

The most catastrophic mode of ground failure caused by liquefaction, flow failure usually occurs on slopes greater than 3°. The flows are principally liquefied soil or blocks of intact material riding on a liquefied subsurface zone. Displacements are commonly tens of meters, but in favorable circumstances, has displaced material tens of miles at velocities of tens of miles per hour. The extensive damage to Seward and Valdez, Alaska, during the 1964 Alaska earthquake was caused by submarine flow failures.

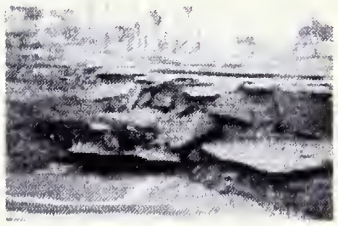
Ground Oscillation

When liquefaction occurs at depth but the slope is too gentle to permit lateral displacement, the soil blocks that are not liquefied may decouple from one another and oscillate on the liquefied zone. The resulting ground oscillation may be accompanied by the opening and closing of fissures and sand boils, potentially damaging structures and underground utilities.

Loss of Bearing Strength

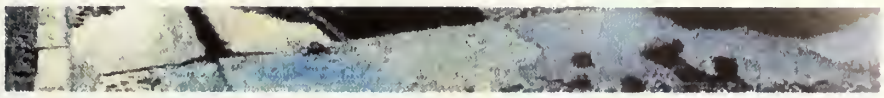
When a soil loses strength and liquefies, loss of bearing strength may occur beneath a structure, possibly causing the building to settle and tip. If the structure is buoyant, it may float upward. During the 1964 Niigata, Japan, earthquake, buried septic tanks rose as much as 3 feet and structures in the Kwangishicho apartment complex tilted as much as 60°. Photo courtesy [insert credit here].

Closer to home, this bridge along State Highway 1 (left) collapsed due to loss of bearing strength during the 1989 Loma Prieta earthquake. Liquefaction also caused pipelines to break where they join structures (right), sometimes starting fires.



Fill subsidence triggered by the 1994 Northridge earthquake caused extensive damage in the Kings Harbor area of Redondo Beach (left).

Such failures can disrupt buried natural gas and water lines, causing fires and hindering efforts to extinguish them (right).



Research into the process and consequences of liquefaction in past earthquakes have linked liquefaction to certain hydrologic and geologic settings, characterized by water-saturated, cohesionless, granular materials situated at depths of less than 50 feet. In simplified terms, the procedure used to delineate areas having significant potential for liquefaction requires development of a liquefaction susceptibility map and a liquefaction opportunity map. The former depicts areas where the geology and hydrology are favorable for liquefaction, and the latter summarizes information about the potential for strong earthquake shaking. When considered together, the two maps determine the liquefaction potential— the relative likelihood that an earthquake will cause liquefaction in an area. The following areas are those identified as being favorable for liquefaction:

1. Areas known to have experienced liquefaction during historic earthquakes.
2. Areas of uncompacted fills containing liquefaction susceptible material that are saturated, nearly saturated, or may be expected to become saturated.
3. Areas where sufficient existing geotechnical data and analyses indicate that the soils are potentially liquefiable.
4. Areas containing young (less than 15,000 years) soils where there is limited or no geotechnical data.

For details on the specific parameters that guide development of the liquefaction hazard zone maps, see Section II of the zoning guidelines.

Amplified Shaking and Amplified Shaking Hazard Zones

In past earthquakes, scientists have noted that some sites seem to experience significantly greater shaking than others. Investigations suggest that topography and the shape of the rocks in the subsurface (deep sedimentary basins) actually cause the shaking to be amplified and produce greater damage. Based on these observations, the State Mining and Geology Board identified amplified ground shaking as a hazard that warrants development of hazard maps. However, as of August 1996, after reviewing current understanding and available technology, the Seismic Hazards Mapping Act Advisory Committee recommended that development of the maps be deferred for at least a few more years. They found that techniques for mapping the hazard are not yet developed and would significantly change during the next few years. Given our current understanding, it is unlikely that amplified shaking hazard zone maps produced today would be cost-effective.

Earthquake-Induced Landslides and Earthquake-Induced Landslide Hazard Zones

Earthquakes have caused rockfalls, rock avalanches, debris flows, bluff collapse, and other types of potentially damaging landslide movements. The photo to the right shows a home that was undermined by a landslide triggered by the 1994 Northridge earthquake (LA Times Photo).

Landslides were widespread during the 1906 San Francisco earthquake.

Landslides tend to occur in loosely consolidated, saturated soils on sloping terrain. Landslides also tend to form distinctive landforms (scarps, troughs, disrupted drainages, etc.) that can be recognized by most trained geologists. Other types of oversteepened slopes (cliffs, stream banks, saturated soil-filled swales, man-made cuts and fills, etc.) are often prone to collapse when shaken by an earthquake. Research has shown that landslide deposits and certain geologic formations and other earth materials are prone to landslide failure. Water often is a contributing factor to landslide movement; thus springs, seeps, and man-introduced water sources (lawn watering, leach fields, storm drains, and water lines) can influence landslide creation, movement, and extent of damage.

Uses and Limitations of Seismic Hazard Zone Maps

A Seismic Hazard Zone Map does **NOT** show areas that automatically should be excluded from development. Instead, it shows areas where the potential for damage from the mapped hazard is great enough so as to make it prudent to conduct geologic investigations to identify and mitigate the hazard prior to development. It is less costly to incorporate hazard mitigation into a structure before it is built than to try to try to later add mitigating features.

Cookie-cutter design of mitigation features is not feasible. The hazards present at each site and the multiplicity of structural configurations makes it impossible to predict how much mitigation will cost. In some areas, it may be possible to adequately mitigate liquefaction hazard by strengthening the foundation to withstand displacements of 1½ feet, typically costing only $3,000-4,000. Expert engineers indicate that in many locations this simple measure could have reduced the payout for repair of liquefaction damage from an average of $65,000 to $70,000 to about $10,000 to $15,000—a substantial savings. Insurance industry representatives indicate that such potential savings could be passed on to consumers in the form of lower earthquake insurance premiums. However, the cost of mitigation of hazards on sites likely to experience more that 1 foot of liquefaction-caused displacement or having a significant landslide hazard is likely to be much greater.

In the past, land-use planners have often assumed that lower density developments should occur where geologic hazards are present. However, planners may find that the high cost of mitigating liquefaction hazards along streams, bays, canals, and coastal zones requires a higher density of development to be economically feasible.

Other things to note:

1. Seismic Hazard Zone Maps may not show all areas that have the potential for liquefaction, landsliding, strong ground shaking or other earthquake and geologic hazards.
2. A single earthquake capable of causing liquefaction or triggering landslide failures will not uniformly affect the entire area zoned.
3. Seismic Hazard Zone Maps do not show Alquist-Priolo Earthquake Fault Zones. Please refer to the latest Official Maps of Earthquake Fault Zones for disclosures and other actions required by the Alquist-Priolo Earthquake Fault Zoning Act.

4. The identification and location of liquefaction and earthquake-induced landslide hazard areas are based on available data. The quality of data used is varied. The information depicted on the maps has been drawn as accurately as possible at 1:24,000-scale.
5. Information on the Seismic Hazard Zone Maps is not sufficient to serve as a substitute for the geologic and geotechnical site investigations requires under the Seismic Hazard Mapping Act or the Alquist-Priolo Earthquake Fault Zoning Act.

Effect of Mitigation Measures on Zones

There are many ways to mitigate seismic hazards, including:

- Strengthening of foundations
- Lowering water tables
- Densifying ground
- Use of piles,

[More text to be added...]

AVAILABILITY OF SEISMIC HAZARDS ZONES MAPS

As indicated above, the first sixteen (16) Official Maps of Seismic Hazard Zones are now available. A reproducible copy has been provided free of charge to affected cities and counties. Other interested persons may purchase copies for the cost of reproduction from BPS Reprographic Services. (Some city and county planning agencies make copies available for purchase.)

CONTACT	PRICE INFORMATION
BPS Reprographics Services *149 Second Street* *San Francisco, CA 94105* *Telephone: (415) 512-6550* *Attn: Juanita*	1:24,000-scale Bond: • $7.00 Minimum charge per order • $1.90 First Copy • $1.32 Additional copies of Same Map • $4.09 Handling Charge (per order) • Plus: Tax and Shipping [Prices subject to change.]

We are experimenting with converting the maps to GIF form (for distribution via the World Wide Web) and various GIS program formats (for distribution from our ftp site). Several of the maps are available in one or more GIS formats. We also plan to make technical information on which the maps are based available via the Web and ftp. As these products become available, they are announced at our web site (http://www.consrv.ca.gov/dmg/shezp/).

The following linked file (or section in the document) is not yet available:

- REFERENCES [Not yet posted]

APPENDICES

- The Seismic Hazards Mapping Act
- Seismic Hazards Mapping Regulations
- Guidelines for Zoning

Jump to Seismic Hazards Mapping Home Page

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PUBLIC RESOURCES CODE
Division 2. Geology, Mines, and Mining

CHAPTER 8
STRONG-MOTION INSTRUMENTATION PROGRAM

Last Updated: Jan-02-1996

Chapter 8 Index

- 2700. Establishment of program
- 2701. Organization and monitoring of program
- 2702. Purchase and installation of instruments
- 2703. Maintenance of instruments; dissemination of data
- 2704. Legislative intent
- 2705. Fee basis and collection
- 2705.5 Deposit of fees in seismic hazards identification fund; information for building permit applicants
- 2706. Fund; appropriation
- 2707. Reduction of fee
- 2708. [Repealed] Exemptions from fees
- 2709. Recession of exemption; request
- 2709.1. Installation contingent on funds received; Structural types subject to section

CHAPTER 8
STRONG-MOTION INSTRUMENTATION PROGRAM

2700. Establishment of program

There is hereby established in the State of California a strong-motion instrumentation program for the purpose of administering the program and of acquiring strong-motion instruments and installing and maintaining such instruments as needed in representative geologic environments and structures throughout the state.

2701. Organization and monitoring of program

The division shall organize and monitor the program with the advice of the Seismic Safety Commission.

2702. Purchase and installation of instruments

The division shall purchase, install, and maintain instruments in representative structures and geologic environments throughout the state, and shall process the data obtained from such instruments resulting from periodic earthquakes, as deemed necessary and desirable by the Seismic Safety Commission.

2703. Maintenance of instruments; dissemination of data

The division shall maintain and service the strong-motion instruments installed, shall collect and interpret all records from the instruments, and shall make the records, record interpretations, and technical assistance available to the construction industry.

2704. Legislative intent

It is the intent of the Legislature in enacting this chapter to provide adequate instrumentation throughout California.

2705. Building permit fees; Retention of percentage by city or county

(a) All counties and cities shall collect a fee from each applicant for a building permit. Each such fee shall be equal to a specific amount of the proposed building construction for which the building permit is issued as determined by the local building officials. The fee amount shall be assessed in the following way:

(1) Group R occupancies, as defined in the 1985 Uniform Building Code and adopted in Part 2 (commencing with Section 2-101) of Title 24 of the California Code of Regulations, one to three stories in height, except hotels and motels, shall be assessed at the rate of ten dollars ($10) per one hundred thousand dollars ($100,000), with appropriate fractions thereof. Of the amount assessed, three dollars ($3) per one hundred thousand dollars ($100,000), with appropriate fractions thereof, shall be deposited in the Seismic Hazards Identification Fund.

(2) All other buildings shall be assessed at the rate of twenty-one dollars ($21) per one hundred thousand dollars ($100,000), with appropriate fractions thereof. Of the amount assessed, six dollars ($6) per one hundred thousand dollars ($100,000), with appropriate fractions thereof, shall be deposited in the Seismic Hazards Identification Fund.

(3) The fee shall be the amount assessed under paragraph (1) or (2), depending on building type, or fifty cents ($0.50), whichever is the higher.

(b)

(1) In lieu of the requirements of subdivision (a), a county or city may elect to include a rate of ten dollars ($10) per one hundred thousand dollars ($100,000), with appropriate fractions thereof, in its basic building permit fee for any Group R occupancy defined in paragraph (1) of subdivision (a), and a rate of twenty-one dollars ($21) per one hundred thousand dollars ($100,000), with appropriate fractions thereof, for all other building types. If collection of the fee is made pursuant to this subdivision, the amount of the fees required to be deposited in the Strong-Motion Instrumentation Special Fund pursuant to Section 2706 shall be equal to the sum of 0.007 percent of the total valuation of any Group R occupancy defined in paragraph (1) of subdivision (a), plus 0.015 percent of the total valuation of all other building types, for which building permits were issued during the accounting period. The remaining amount of fees shall be deposited in the Seismic Hazards Identification Fund pursuant to Section 2699.5. A county or city electing to collect the fee pursuant to this subdivision need not segregate the fees in a fund separate from any fund into which basic building permit fees are deposited.

(2) "Building," for the purpose of this chapter, is any structure built for the support, shelter, or enclosure of persons, animals, chattels, or property of any kind.

(c)

(1) A city or county may retain up to 5 percent of the total amount it collects under subdivision (a) or (b) for data utilization, for seismic education incorporating data interpretations from data of the strong-motion instrumentation program and the seismic hazards mapping program, and, in accordance with paragraph (2), for improving the preparation for damage assessment after strong seismic motion events.

(2) A city or county may use any funds retained pursuant to this subdivision to improve the preparation for damage assessment in its jurisdiction only after it provides the Department of Conservation with information indicating to the department that data utilization and seismic education activities have been adequately funded.

2705.5. Deposit of fees in seismic hazards identification fund; information for building permit applicants

The Division of Mines and Geology shall advise all counties and cities as to that portion of the total fees charged pursuant to Section 2705 which is to be deposited in the Seismic Hazards Identification Fund, so that this information may be provided to building permit applicants.

2706. Fund; creation; appropriation

(a) All fees collected pursuant to Section 2705, except for those fees required to be deposited in the Seismic Hazards Identification Fund pursuant to Section 2705, shall be deposited in the State Treasury in the Strong-Motion Instrumentation Special Fund, which fund is hereby created, to be used exclusively for the purposes of this chapter. All moneys in that fund are continuously appropriated to the division for the purposes of this chapter.

(b) This section shall become operative April 1, 1991.

2707. Reduction of fee

The division, upon advice of the Seismic Safety Commission, whenever it determines that an adequate instrumentation program has been achieved, may reduce the fee levied against building permits as provided in Section 2705 to a level sufficient to maintain the program established pursuant to this chapter.

2708. Exemptions from fees [Repealed]

[The repealed section exempted cities and counties from Section 2705 if at least one structure in the community had been instrumented with three accelerographs prior to January 20, 1972, and the city had requested that it be exempted.]

2709. Recession of exemption; request

Any city or county that has been exempted from the provisions of Section 2705 by Section 2708 may participate in the state strong-motion instrumentation program by a written request to the State Geologist by the governing body of such city or county that its exemption be rescinded.

2709.1. Installation contingent on funds received; Structural types subject to section

(a) After January 1, 1988, no strong-motion instrumentation shall be installed pursuant to this chapter in the structural types identified in subdivision (b) unless funds proportionate to the construction value as called for under Section 2705 are received from organizations or entities representing these structural types, or the instrumentation is specifically called for by the Seismic Safety Commission in urgency situations.

(b) The structural types subject to this section include all of the following:

(1) Hospitals.

(2) Dams.

(3) Bridges.

(4) Schools.

(5) Powerplants.

(c) The Strong-Motion Instrumentation Special Fund may accept funds from sources other than the permit fees identified in this chapter. The priority of installations performed under this chapter shall be determined by the Seismic Safety Commission.

Click here to return to Chapter 8 Index

Department of Conservation

California Department of Conservation
Division of Mines and Geology

Table 1. Summary of Responsibilities and Functions Under the Seismic Hazards Mapping Act

Last Revised: September 11, 1997

State Mining and Geology Board

- Develop guidelines and priorities for preparation of Seismic Hazard Zone Maps (PRC Section 2695).
- Formulate policies and criteria to guide cities, counties, and state agencies (PRC Section 2695).
- Receive comments regarding Preliminary Review Maps and transmit them to the State Geologist (PRC Section 2696).

State Geologist

- Compile and issue Preliminary Review Maps and Official Maps of Seismic Hazard Zones to cities, counties, and state agencies (PRC Section 2696).

Cities and Counties

- Post notices at the offices of the county recorder, county assessor, and county planning commission, and other appropriate sites, identifying the location of any Seismic Hazard Zone Maps issued by the State Geologist that cover their county (PRC Section 2694(c)(1)).
- Record information received: Upon receiving copies of the Official Maps of Seismic Hazard Zones, the county recorder shall record all information transmitted as part of the public record (PRC Section 2696(b)).
- Regulate specified "projects" within Seismic Hazards Zones (PRC Section 2697):
    1. Determine the need for geotechnical reports prior to development projects (PRC Section 2697). The purpose, scope, and requirements for project approval are outlined in (CCR Section 3724(c)).
    2. Review and determine acceptabilty of geotechnical reports prior to issuing development permits (PRC Section 2697).
    3. Submit a copy of each acceptable geotechnical report, including the mitigation measures, if any, that are to be taken, to the State Geologist within 30 days of report acceptance (PRC Section 2697). *[Send reports to:*
        California Department of Conservation

Division of Mines and Geology
Attn: Seismic Hazard Reports
801 K Street, MS 12-31
Sacramento, CA 95814-3531

- Take Seismic Hazard Zone Map information into account in the safety element of the general plan and in land-use planning and permitting ordinances (PRC Section 2699).
- Collect building fee and remit to the Department of Conservation (PRC Section 2705). The city or county may retain up to 5 percent for data utilization, certain types of earthquake education, and, under certain circumstances, for improving preparedness for post-earthquake damage assessment.

Other

- **Seismic Safety Commission**— Advise the State Geologist and the State Mining and Geology Board (PRC Section 2695).
- **Sellers of Real Property or Their Agents**— Disclosure: Sellers of any real property located within a Seismic Hazard Zone must notify prospective buyers of that fact (PRC Section 2694).

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The Department of Conservation makes no warranties
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Voice: (916) 323-8569
Fax: (916) 445-3334
E-mail: tsmith@consrv.ca.gov

Local Contact

DMG's local contact for Seismic Hazard Mapping Program coordination is:

_____

A mylar reproducible of the map/s is filed at:

_____

Guideline Orders

To Order Guidelines

Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards in California,* is available for $15 per copy, including tax and postage. Checks, money orders, VISA and MasterCard are accepted.

Send mail orders to:

Division of Mines and Geology
P.O. Box 2980
Sacramento, CA 95812-2980

Map Orders

To order official and preliminary seismic hazard zone maps

BPS Reprographic Services
149 Second Street
San Francisco, CA 94103
(415) 512-6550

Maps must be ordered by quadrangle name (see index map page). Contact BPS for price information.

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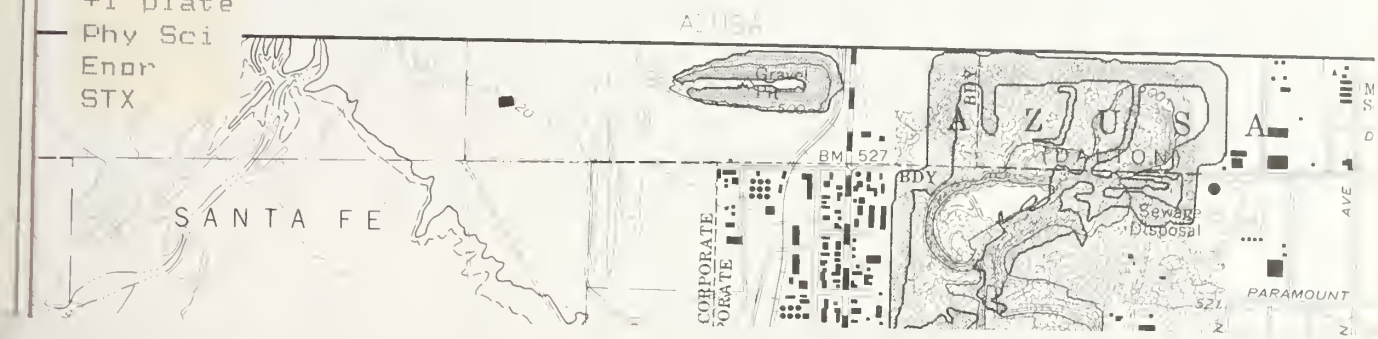

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DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

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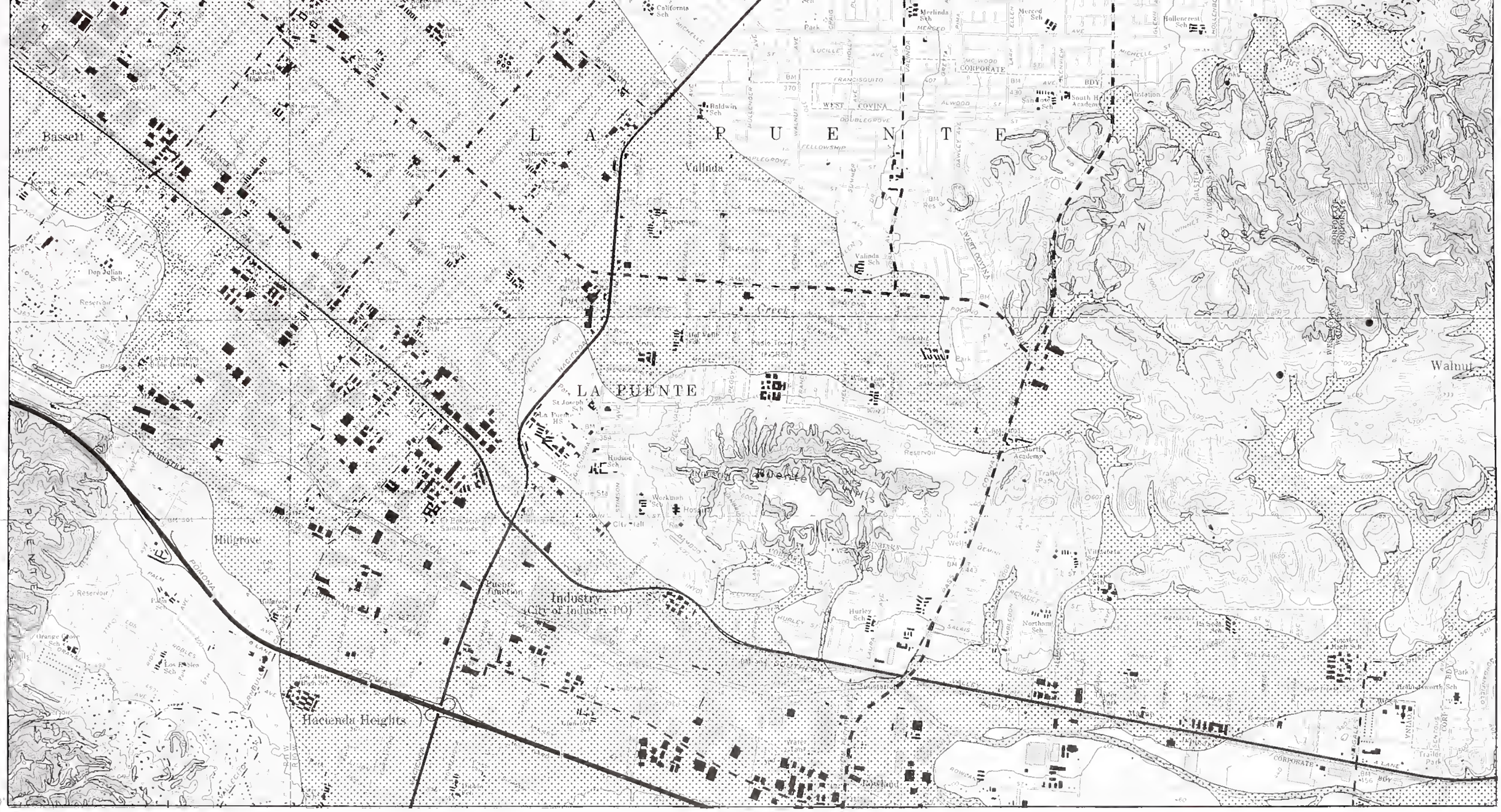
DEPARTMENT OF CONSERVATION–STEVE ARTHUR, CHIEF DEPUTY DIRECTOR

SEISMIC HAZARD ZONES MAP
Baldwin Park Quadrangle

118° 00'
117° 52'30"
34° 07'30"



SCALE 1:24,000

1 .5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

PURPOSE OF MAP

This map will assist cities and counties in fulfilling their responsibilities for protecting the public safety from the effects of earthquake-triggered ground failure as required by the Seismic Hazards Mapping Act (Public Resources Code Sections 2690-2699.6).

For information regarding the scope and recommended methods to be used in conducting the required site investigations, see DMG Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California.

For a general description of the Seismic Hazards Mapping Program, the Seismic Hazards Mapping Act and regulations, and related information, please refer to the draft User's Guide (see http://www.consrv.ca.gov/dmg/shezp/userguid/).

Production of this map was funded by the Federal Emergency Management Agency's Hazard Mitigation Program and the Department of Conservation in cooperation with the Governor's Office of Emergency Services.

IMPORTANT - PLEASE NOTE

1) This map may not show all areas that have the potential for liquefaction, landsliding, strong earthquake ground shaking or other earthquake and geologic hazards. Also, a single earthquake capable of causing liquefaction or triggering landslide failure will not uniformly affect the entire area zoned.

2) Liquefaction zones may also contain areas susceptible to the effects of earthquake-induced landslides. This situation typically exists at or near the toe of existing landslides, downslope from rockfall or debris flow source areas, or adjacent to steep stream banks.

3) This map does not show Alquist-Priolo earthquake fault zones, if any, that may exist in this area. Please refer to the latest official map of earthquake fault zones for disclosures and other actions that are required by the Alquist-Priolo Earthquake Fault Zoning Act. For more information on this subject and an index to available maps, see DMG Special Publication 42.

4) Landslide zones on this map were determined, in part, by adapting methods first developed by the U.S. Geological Survey (USGS). A new generation of landslide hazard maps being prepared by the USGS (Jibson and Harp, in preparation) uses an experimental approach designed to explore new methods to assess earthquake-induced landslide hazards. Although aspects of this new methodology may be incorporated in future seismic hazard zone maps, the experimental USGS maps should not be used as substitutes for these official earthquake-induced landslide zone maps.

5) U.S. Geological Survey base map standards provide that 90 percent of cultural features be located within 40 feet (horizontal accuracy) at the scale of this map. The identification and location of liquefaction and earthquake-induced landslide zones are based on available data. However, the quality of data used is varied. The zone boundaries depicted have been drawn as accurately as possible at this scale.

6) Information on this map is not sufficient to serve as a substitute for the geologic and geotechnical site investigations required under Chapters 7.5 and 7.8 of Division 2 of the Public Resources Code.

7) DISCLAIMER: The State of California and the Department of Conservation make no representations or warranties regarding the accuracy of the data from which these maps were derived. Neither the State nor the Department shall be liable under any circumstances for any direct, indirect, special, incidental or consequential damages with respect to any claim by any user or any third party on account of or arising from the use of this map.

STATE OF CALIFORNIA

SEISMIC HAZARD ZONES

Delineated in compliance with
Chapter 7.8, Division 2 of the California Public Resources Code
(Seismic Hazards Mapping Act)

BALDWIN PARK QUADRANGLE

OFFICIAL MAP

Released: March 25, 1999

STATE GEOLOGIST

MAP EXPLANATION

Zones of Required Investigation:

Liquefaction
Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Overlapping Liquefaction and Earthquake-Induced Landslides
Areas that lie within zones of required investigation for both liquefaction and earthquake-induced landslides. (See above for explanation of each zone.)

DATA AND METHODOLOGY USED TO DEVELOP THIS MAP ARE PRESENTED IN THE FOLLOWING:

Seismic Hazard Evaluation of the Baldwin Park 7.5 minute quadrangle, Los Angeles County, California: California Division of Mines and Geology, Open-File Report 98-13

For additional information on seismic hazards in this map area, the rationale used for zoning, and additional references consulted, refer to DMG's World Wide Web site (http://www.consrv.ca.gov/dmg/).

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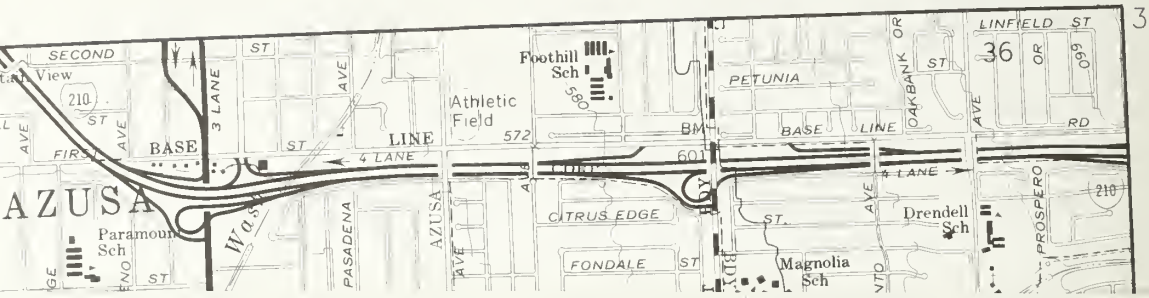
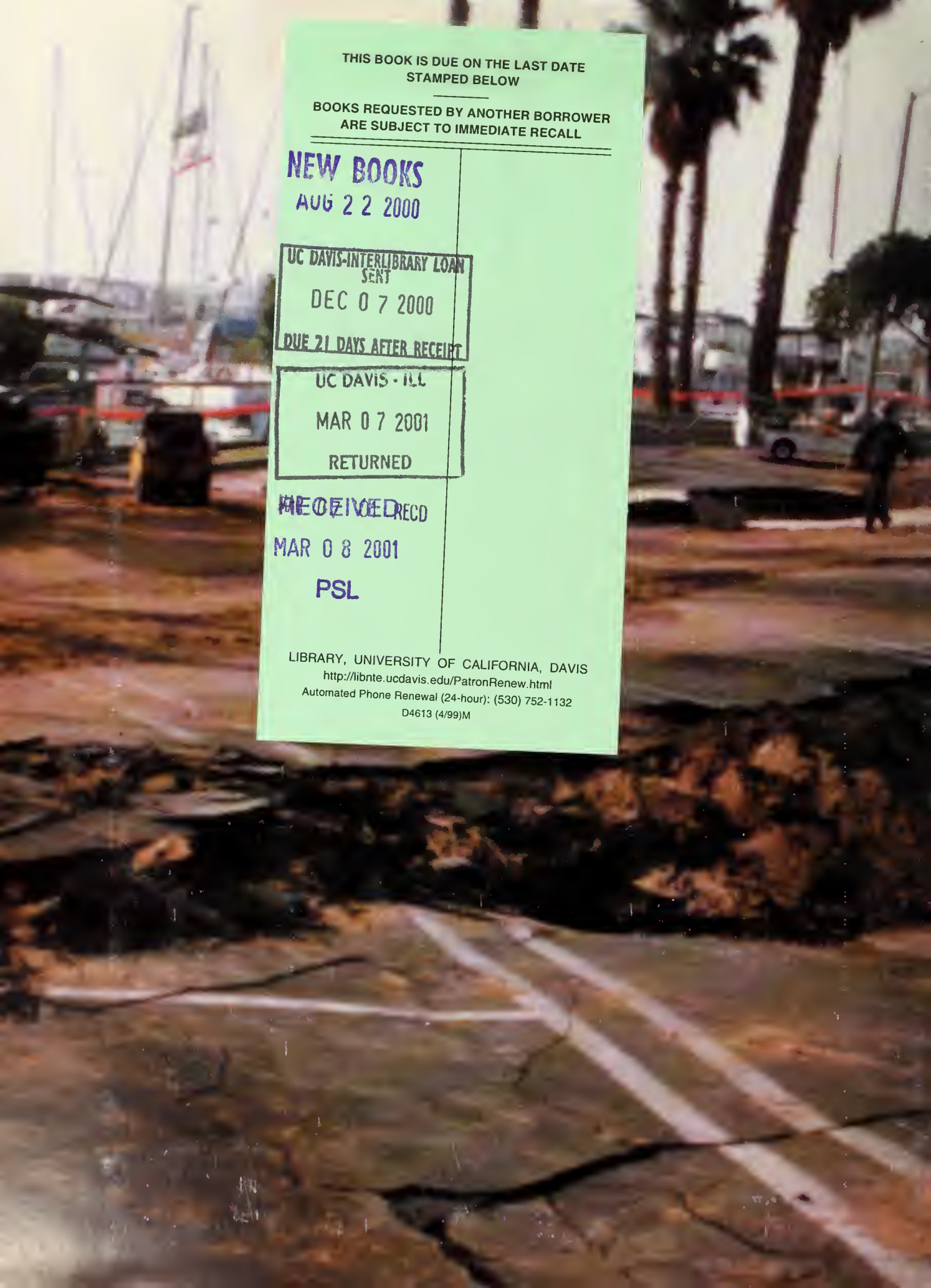
SEISMIC HAZARD ZONES MAP
Baldwin Park Quadrangle

117° 52'30"

GLENDORA

34° 07'30"





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